

DVD+ReWritable
Video Format Specifications

System Description

Version 3.0

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DVD+RW Video Format Specifications

Conditions of Publication

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1. General

1.1 About this document

This document specifies the DVD+RW Video Format intended for home video recording on DVD+RW media. DVD+RW Video discs are playback compatible with most DVD-Video players.

This is a draft document intended for review by the DVD+RW Alliance.

Version 2.0 adds improved support for the combination of video and data files on the same physical disc. In addition to this it allows for more menu and navigation flexibility and is prepared for content protection.

In Version 2.1 an Intermediate DVD+RW Video disc format for video and other data files is added to improve disc preparation and eject times. Also, alignment with the Vidi specification for content protection has been improved. Version 1 and version 2 video formats are now described in a single document.

In Version 3.0 an additional table is added to the VRMI General Information (VRMI_GI) to provide information about the copy protection status of the data in each cell. Versions 1, 2 and 3 video formats are now described in this single document.

1.2 Scope

This document defines the data structures related to the video and data file recording application. The mechanical, optical and physical characteristics of the recording medium, the low-level data format and the recording method are specified in the DVD+RW System Specification [7].

1.3 Application overview

The DVD-Video format as defined in the DVD Specifications for Read-Only Discs [9] was created for storing movies and other video content on read-only DVD media. Some of the features of the DVD-Video format make it less suitable for real-time recording applications. However, it is possible to create and record video streams and associated data structures on re-writable media in real time which are almost identical to the structures defined in the DVD-Video format. These re-writable discs are playback compatible with the majority of the installed base of consumer DVD-Video players. This document describes the format for DVD-Video compatible real-time recording of video streams.

Besides the DVD-Video data structures that are almost similar to those defined in [9], additional data structures are defined: the so-called Video Recording Manager Information (VRMI). Recorders are required to create and update VRMI whenever a recording is made or manipulated. VRMI contains data that does not fit in the DVD-Video data structures, but can be used by recorders for various purposes. Examples of this are menu reconstruction after a recording has been made and recording of user defined play back sequences. In this new version of the specifications, VRMI contains additional fields that indicate which part of the disc is reserved for video and which part for data files. The data formats themselves are not constrained by this specification.

Besides the real-time data streams, the menus recorded by DVD+RW Video recorders are compatible with DVD-Video players. They provide easy access to the recorded content on both DVD+RW Video recorders and DVD-Video players. This new version of the specifications allows for more space for the menus.

1.4 References and conformance

- [1] ISO/IEC 11172-2: 1993 *Information technology – Coding of moving pictures and associated audio for digital storage media at up to about 1,5 Mbit/s – Part 2: Video (MPEG-1 Video)*
- [2] ISO/IEC 11172-3: 1993 *Information technology – Coding of moving pictures and associated audio for digital storage media at up to about 1,5 Mbit/s – Part 3: Audio (MPEG-1 Audio)*
- [3] ISO/IEC 13818-1: 1995 *Information technology – Generic coding of moving pictures and associated audio information: Part 1: Systems (MPEG-2 Systems)*
- [4] ISO/IEC 13818-2: 1995 *Information technology – Generic coding of moving pictures and associated audio information: Part 2: Video (MPEG-2 Video)*
- [5] ISO/IEC 13818-3 Second Edition: 1998 *Information technology – Generic coding of moving pictures and associated audio information: Part 3: Audio (MPEG-2 Audio)*
- [6] ATSC Doc. A/52, 20 Dec 95: *Digital Audio Compression Standard (AC-3)*
- [7] Hewlett-Packard, Mitsubishi Chemical, Philips, Ricoh, Sony, Yamaha: *DVD+RW 4.7 Gbytes Basic Format Specifications (Version 1.2, December 2002)*
- [8] *DVD Specifications for Read-Only Disc - Part 2: File System Specifications (Version 1.0, August 1996)*
- [9] *DVD Specifications for Read-Only Disc - Part 3: Video Specifications (Version 1.1, December 1997, including supplemental information up to January 2001)*
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- [14] ISO/IEC 8859-1: 1998 *Information processing – 8-bit single-byte coded graphic character sets – Part 1: Latin alphabet No.1*
- [15] IEC 60958-1, 1999: *Digital Audio Interface - Part 1: General*
- [16] IEC 60958-3, 1999: *Digital Audio Interface - Part 3: Consumer Applications*
- [17] IEC 61937, 2000: *Digital audio - Interface for non-linear PCM encoded audio bitstreams applying IEC 60958*
- [18] IEC 61880, 1998: *Video and accompanied data using the vertical blanking interval – Analogue interface*
- [19] EIA/CEA-805, October 2000: *Data Services on the Component Video Interfaces*
- [20] ISO/IEC 13346:1995 *Information technology – Volume and file structure of write-once and rewritable media using non-sequential recording for information interchange*
- [21] OSTA UDF 1.02, 1996 *Universal Disk Format Specification (Revision 1.02)*

- [22] Philips, *Video Content Protection System for the DVD+R/+RW Recording Format, System Description (Version 1.3)*

1.5 Definitions

1.5.1 Access unit

Coded representation of a presentation unit. See [3] for a more detailed definition of MPEG audio and video access units and [9] for a detailed definition of a Sub-picture (access) Unit.

1.5.2 Buffer Cell

Last Cell or first part of the last Cell of a Video Object in the VTS Title VOBS of a DVD+RW Video disc. The Buffer Cell is not used by any Program Chain. Cell ID number 255 is reserved for exclusive use by Buffer Cells. However, other Cell ID numbers may be assigned to a Buffer Cell as long as it is different from the Cell ID of the preceding Cell in the VOB.

1.5.3 Cell

Sequence of one or more Video Object Units. Cells are the basic presentation units for the Program Chains. In DVD+RW Video the maximum presentation period of the Cell is restricted, depending on the average (target) bitrate of the VOB. See also the definition of Buffer Cell.

1.5.4 Chapter

Subdivision of a Title in a DVD-Video compatible way, other word for Part_of_Title (PTT). Not to be confused with VR Chapters.

1.5.5 Data Section

Area in the Data Zone intended for storing additional data files. It can for example be used to store picture files, meta-data files, audio files, etc. Allocation rules for this area are designed to fit with existing read/write implementations. The format of the data files is not constrained by this specification.

1.5.6 Data Zone

Area on a DVD+RW disc between Lead-in Zone and Lead-out Zone or temporary Lead-out Zone. The Data Zone contains a single Logical Volume Space.

1.5.7 DVD+RW disc

ReWritable optical medium that complies with the specifications defined in [7].

1.5.8 DVD+RW Video data

Any data recorded in the DVD-Video Zone or belonging to the Video Recording Manager.

1.5.9 DVD+RW Video disc

DVD+RW disc containing DVD+RW Video data structures according to the DVD+RW Video Format.

1.5.10 DVD+RW Video format

Short for 3122 783 0172 8DVD+RW Video Format Specifications.

1.5.11 DVD-Video format for read-only discs

Format as specified in [9].

1.5.12 DVD-Video Zone

Contiguous piece of the Data Zone on a DVD-Video or DVD+RW Video disc that contains the DVD-Video compatible data structures.

1.5.13 ECC Block

Entity defined in [7]. One ECC Block is a contiguous piece of the written bit-pattern comprising 16 Logical Sectors. ECC Blocks are aligned with the start of the Data Zone.

1.5.14 Elementary stream

An elementary stream is a generic term for a sequence of coded video, coded audio, coded graphics or other access units that can be correctly decoded by a hypothetical decoder operating without special control from an external controller.

1.5.15 Empty Program Chain (Empty PGC)

Special kind of PGC used by Free Space Titles and empty Play List Titles. An Empty PGC contains just one Cell, which should never be played.

1.5.16 Free Space

Recording which is made inaccessible via the Program Chains or other area on the disc, represented by a Free Space Title in the list of Full Titles in the Title Search Pointer Table.

1.5.17 Free Space Title

Full Title or Play List Title which acts as a placeholder for available free space on the disc. The related Program Chain is an Empty PGC. Time_Play(), Time_Search(), PTT_Play() and PTT_Search() for a Free Space Title are blocked by setting the appropriate bits in the TT_SRPT.

1.5.18 Full Title

Title representing one Recording.

When a Full Title that is not tagged as Free Space is played, complete Cells (except the Buffer Cells) contained in the Recording are played in the order of data allocation in the VTS Title VOBS.

1.5.19 Group of Pictures (GOP)

Series of coded pictures starting with a GOP-header followed by an intra coded picture. The GOP represents up to 36 display fields at a rate of 59.94 Hz, or 30 fields at a rate of 50 Hz.

1.5.20 Key Frame

Video frame that may be used as a visual representation for the disc, a Recording or a VR Chapter.

1.5.21 Logical Block / Logical Block Number

A Logical Block is a data allocation unit within the Logical Volume Space. Logical Block Numbers are assigned in ascending order to consecutive Logical Blocks starting from 0 at the start of the Logical Volume Space. The size of a Logical Block shall be 2048 bytes.

1.5.22 Logical Sector / Logical Sector Number

A Logical Sector is a data allocation unit within the Data Zone of a DVD+RW disc. Logical Sector Numbers are assigned in ascending order to consecutive Logical Sectors starting from 0 at the start of the Data Zone. The size of a Logical Sector shall be 2048 bytes.

1.5.23 MPEG-2 Program Stream (MPEG-2 PS)

Program Stream as defined in [3].

1.5.24 Multiplexed stream

A multiplexed stream is a single bit-stream, combining one or several elementary streams that can be played in synchronism.

1.5.25 Play List Title

DVD-Video Title representing a play back sequence of Cells from one Recording. If the Play List is empty, the Play List Title refers to an Empty Program Chain.

1.5.26 Program Chain (PGC)

Playback sequence of Cells for the presentation of a Menu or a Title.

1.5.27 Real Title

Full Title or Play List Title that is not a Free Space Title.

1.5.28 Recording

Contiguous piece of the VTS Title VOBS, enclosing an integer number of Logical Blocks.

The VTSTT_VOBS is partitioned into a maximum of 49 adjacent Recordings, optionally followed by other data (e.g. unused remnants of a previous Recordings). Each Recording delimits the scope of a Full Title.

1.5.29 Title

User accessible entry in the Title Search Pointer Table.

1.5.30 Title Menu

Menu that gives the user access to non-empty Real Play List Titles and optionally to other Titles.

1.5.31 Title Search Pointer Table

Table in the Video Manager listing all available Play List Titles and Full Titles on the disc. It is a starting point for finding the data which is relevant for playing back a Title.

1.5.32 Video Manager (VMG)

DVD-Video data structures containing information about the recorded video data and the Title Menu. The Title Search Pointer Table is one of the elements of the Video Manager.

1.5.33 Video Object (VOB)

A Video Object is (a part of) a sequence of contiguously recorded Cells, together constituting (a part of) an MPEG-2 Program Stream.

An integer number of MPEG-2 Program Stream packs may be missing from the beginning of the first Cell of the VOB, if this Cell is not used by any Title. The last Cell of a VOB is a Buffer Cell. At least the first NV_PCK of the Buffer Cell shall be included at the end of a VOB. An integer number of MPEG2 PS packs may be omitted from the end.

According to the DVD-Video specifications a VOB may also contain up to eight Audio streams (in elementary Audio streams and/or in Private streams). The DVD+RW Video format allows the use of the same eight Audio stream numbers, but only up to two of the streams will be available for the user simultaneously.

In DVD-Video up to 32 Sub-picture streams are available. In DVD+RW Video only one Sub-picture stream is used within the same VOB.

1.5.34 Video Object Unit (VOBU)

Integer number of MPEG-2 Program Stream packs representing a presentation period between 0.4 and 1.0 seconds. The last VOB of a Cell has a maximum presentation period of 1.2 seconds. Video data in a VOB consists of an integer number of GOPs and starts with a sequence header, a GOP header and an intra coded picture. In DVD+RW Video a VOB shall contain at least one coded Video frame.

A Sub-picture Unit is optional in a VOB and cannot cross VOB boundaries. The SPUs associated validity period ends at or before the end presentation time of the VOB.

1.5.35 Video Object Set (VOBS)

Collection of VOBs. DVD-Video requires that the VOBs are recorded adjacently in a Video Object Set. However, DVD+RW Video allows that sequence of logical blocks with data that does not belong to any VOB is recorded immediately before or after any VOB in the VOBS.

VOBs which are used for the menus are stored in the Video Manager VOBS (VMGM_VOBS). VOBs which are used for the Titles are stored in the VTS Title VOBS (VTSTT_VOBS).

In DVD+RW Video there is only one VTSTT_VOBS. The Video Objects for the Titles of all VTSes are stored in this single VOBS.

1.5.36 Video Recording Manager

Data structures recorded on a DVD+RW disc in addition to the data structures in the DVD-Video Zone to support the video recording application.

1.5.37 VR Chapter

Single piece of the presentation of the Full Title of a Recording, defined in VRMI. VR Chapters are frame accurate and can be created instantly without making any changes to the VTSTT_VOBS. Presentation of a VR Chapter ideally starts from the VR Chapter Marker and ends just before the next VR Chapter Marker or with the last presentation frame of the last Cell included in the Full Title if there is no next VR Chapter Marker in this Recording.

1.5.38 VR Chapter Marker

Data structure pointing to a frame included in the presentation of a Full Title of a Recording, which is the start of a VR Chapter.

1.5.39 VR Play List

User defined play list of VR Chapters. DVD+RW Video recorders may support the possibility to convert a VR Play List for a Recording into a Play List Title.

1.5.40 Video Title Set (VTS)

Collection of Titles. On DVD+RW Video discs up to three VTSes may be recorded.

1.6 Notations

Numbers in decimal notation are represented by a sequence of one or more decimal digits (0,1,2,3,4,5,6,7,8,9).

Numbers in hexadecimal notation are represented by a sequence of one or more hexadecimal digits (0,1,2,3,4,5,6,7,8,9,A,B,C,D,E,F), suffixed by "h".

Numbers in binary notation are represented by a sequence of one or more binary digits (0,1), suffixed by "b".

Numbers in BCD notation are represented by a sequence of one or more decimal digits between a pair of square brackets. Example: [59].

All bits of fields that are specified to be **reserved** contain the value 0b unless specified otherwise.

1 kB represents 2^{10} bytes.

1 MB represents 2^{20} bytes.

1 Mbps represents 10^6 bits per second.

Counting of Logical Blocks starts from zero.

If a parameter describes the address of a certain Logical Block with **RLBN** from the first LB of a field, this parameter is equal to the number of that LB counted from the first LB of the field.

When a field within a data structure has **RBP n**, this shall mean that the first byte of that field is at relative byte position n from the start of the data structure. The first byte of the data structure is at RBP 0.

1.7 Acronyms

AVDP	Anchor Volume Descriptor Pointer
BCD	Binary Coded Decimal
BL	Bitrate Level
CBR	Constant Bit Rate
CGMS	Copy Generation Management System
CVBR	Constrained Variable Bitrate
DCB	Disk Control Block
DVD	Digital Versatile Disc
DVD+RW	ReWritable disc according to the DVD+RW System Description [7]
EPN	Encryption Plus Non-assertion
FP_PGC	First Play Program Chain
FS	File System
FID	File Identifier Descriptor
FSD	File Set Descriptor
GOP	Group Of Pictures
LB	Logical Block
LSN	Logical Sector Number
LVID	Logical Volume Integrity Descriptor
MP@ML	Main Profile at Main Level
MPEG	Moving Picture Experts Group (ISO/IEC JTC1/SC29 WG11)
NV_PCK	Navigation Pack
PCM	Pulse Code Modulation
PES	Packetized Elementary Stream
PGC	Program Chain
PGCI	Program Chain Information
PS	Program Stream
PSN	Physical Sector Number
P-STD	Program stream System Target Decoder
PTS	Presentation Time Stamp
RBP	Relative Byte Position
RLBN	Relative Logical Block Number
RT	Real Time
SCR	System Clock Reference
SPU	Sub-picture Unit
TT_SRPT	Title Search Pointer Table
TTU	Title Unit
UDF	Universal Disk Format
UOP	User Operation
USB	Unallocated Space Bitmap
UTC	Universal Time
VBR	Variable Bit Rate
VCPS	Video Content Protection System
VMG	Video Manager
VMGI	Video Manager Information
VMGM	Video Manager Menu
VOB	Video Object
VOBs	Video Objects
VOBS	Video Object Set
VOBU	Video Object Unit
VR	Video Recording
VRM	Video Recording Manager
VRMI	Video Recording Manager Information
VRPL	Video Recording Play List
VTs	Video Title Set
VTsI	Video Title Set Information

VTSM Video Title Set Menu
VTSTT_VOBS Video Object Set for Titles in a VTS

2. Introduction and File System

2.1 Recording medium

The recording medium for the DVD+RW Video format complies with the DVD+RW Basic Format Specifications [7]. The DVD+RW Data Zone contains a single linear sector address space (volume space) with a data format according to this DVD+RW Video specification.

Depending on the formatting status, three different kinds of DVD+RW Video discs can be discerned, as defined in the following sub-sections.

2.1.1 Fully Formatted DVD+RW Video Disc

The DVD+RW disc is fully formatted as specified in section 21 of [7].

2.1.2 Partly Formatted DVD+RW Video Disc

The DVD+RW disc is partially formatted and the data shall be contiguously recorded followed by a Temporary Lead-Out Zone as specified in section 21 of [7].

2.1.3 Intermediate DVD+RW Video Disc

An Intermediate DVD+RW Video Disc is also partially formatted according to the definition in section 22.2 of [7], but the Data Zone is not contiguously recorded. Such a disc is only allowed when it contains a Data Section, as defined in section 2.3.8. The Data Zone of an Intermediate DVD+RW disc contains 2 contiguously recorded parts with an unrecorded area in between. The first contiguously recorded part starts from the beginning of the Data Zone and shall include all video related files; the second contiguously recorded part includes the Data Section. A Temporary Lead-out Zone follows the Data Zone. The Formatting DCB in the Lead-in Zone reflects the formatting status of the disc (see section 22.2 of [7]).

Note: Intermediate DVD+RW Video discs have a reduced compatibility with DVD read-only devices. It is recommended to convert these discs to Fully or Partly Formatted DVD+RW Discs if the highest level of compatibility is desired.

2.2 Copy Management

2.2.1 General

The video-recording format specified in this document shall not be applied for recording of video content that is indicated as "Copy Never" or as "Copy No More".

2.2.2 RSV field in the Data Frames

Refer to section 13.1.3 of [7]. All bytes of the RSV field in the Data Frames except for the first RSV byte in Data Frames that are part of the Data Zone are reserved and shall be set to (00b).

First RSV byte in Data Frames that are part of the Data Zone:

b7	b6	b5	b4	b3	b2	b1	b0
CPM	reserved	CGMS		APT		reserved	

- CPM ... Copyrighted Material
0b : This Data Frame does not contain copyrighted material
1b : This Data Frame contains copyrighted material
- CGMS ... Copy Generation Management System
If CPM is set to (0b), this field is reserved.
If CPM is set to (1b), the value stored in this field has the following meaning:
00b : The contents of the Data Frame may be copied without restriction.
01b : Reserved
10b : Reserved
11b : The content of the Data Frame is a copy of which no more copies are allowed ("Copy No More").
- APT ... Application Type
00b : This Data Frame does not contain data belonging to files included in the VIDEO_RM or the VIDEO_TS directory.
01b : This Data Frame contains or may contain data belonging to files included in the VIDEO_RM or the VIDEO_TS directory.
10b : Reserved
11b : Reserved

Note: This specification allows that APT for all sectors in the Data Zone of a DVD+RW Video disc be set to 01b.

Note: Recorders and recording drives shall be considered as circumvention devices when these are produced to record, or can be modified to record, in any manner, a user-defined number in the RSV field.

2.2.3 Content Provider Information

Refer to section 17.11.3 of [7]. All bytes of the Content Provider Information field shall be set to (00h).

Note: Recorders and recording drives shall be considered as circumvention devices when these are produced to record, or can be modified to record, in any manner, a user-defined number in this field.

2.2.4 Copy Generation Management System

CGMS fields in the File System may be set to (00b) for files with CGMS fields set to (00b) in all Data Frames with data belonging to the file. CGMS fields in the File System shall be set to (11b) for files

with the CGMS field set to (11b) in at least one of the Data Frames with data belonging to the file. CGMS fields in the File System shall never be set to (01b) or (10b).

Note: In some cases a video recording application cannot always be sure that for a certain file, all CGMS fields in the Data Frame headers are set to (00b). In that case the CGMS field for the file shall be set to (11b).

In addition to the CGMS fields in the File System and in the RSV fields of the Data Frames, recorders shall set the Real-Time CGMS fields in the Real-Time Attributes as defined in 3.4.1. Real-Time CGMS is intended to provide the most accurate CGMS status. The CGMS bits in the RSV field shall not be set to (00b) for any of the Data Frames belonging to a VOB for which Real-Time CGMS bits are set to (11b).

During playback, CGMS bits (preferably the Real-Time CGMS bits) shall be taken into account. For recorded content that is labeled as "Copy No More", the video output signal shall contain copy control information indicating that copying is not permitted (e.g. through CGMS bits as in [10], [18] and [19]) and/or that copyright is asserted and copying is restricted (e.g. through copyright information bits as in [12]), whichever is applicable for the video output signal type.

2.2.5 Content Protection System

This version of the DVD+RW Video specification has been prepared for recording video that is protected by means of a content protection system based on cryptographic principles. The content protection method can be specified in one of the fields of the Video Recording Management Information (refer to 4.2).

Note: The use of a content protection system may require special versions of the media.

2.2.6 Analog Protection System trigger bits

APS trigger bits (APSTB) in the DVD-Video Zone shall be set to (00b) for all content that is not protected by means of a content protection method.

2.3 Data Zone layout

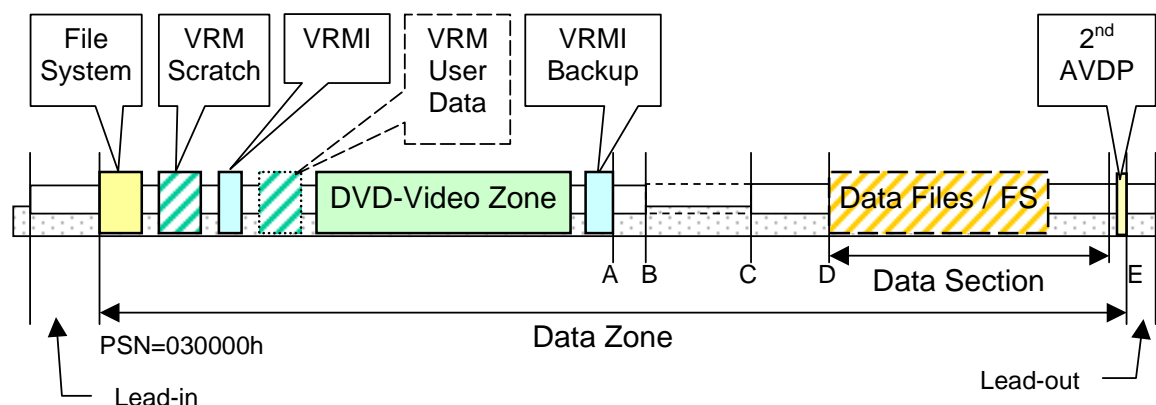


Figure 1: General layout

2.3.1 General layout

The relative location of the various data structures in the Data Zone with a single volume space of a DVD+RW Video disc is depicted in Figure 1. The volume space optionally contains a Data Section with Data Files and related File System information. No file or file system data (except 2nd AVDP) is located past the end of the Data Section.

On a Fully or Partly formatted DVD+RW Video disc, all sectors of the Data Zone shall be written. On an Intermediate DVD+RW Video disc, part of the area indicated as B-C (after VRMI Backup and before the Data Section) may be left unwritten. In that case the following rules shall be applied:

- Padding area A-B: It is highly recommended that at least 64 ECC Blocks immediately following the ECC Block containing VRMI Backup shall be recorded with arbitrary data. All new implementations shall follow this recommendation.
- Padding area C-D: At least 256 ECC Blocks in front of the Data Section shall be recorded with arbitrary data.
- Area C-E: The total size of the contiguously written area from the start of padding area C-D until the end of the Data Zone (E) shall be at least 896 ECC Blocks.

2.3.2 File System data including 2nd AVDP

File System data structures are located (1) before the first DVD+RW Video data, (2) optionally partly in between or after DVD+RW Video files and (3) in the Data Section (if present) according to the rules defined in section 2.4. The 2nd AVDP contains the backup of the UDF Anchor Volume Descriptor Pointer and is stored in the last sector of the volume space.

2.3.3 VRM Scratch

VRM Scratch is a mandatory area with a fixed size of 1 MB, which may be used by recorders to temporarily store data. The format of these structures is not defined in this specification.

Note: Recorders should not rely on the integrity of the contents of this area once a disc has been taken out of the drive. Another recorder might have changed VRM Scratch without making changes to any other DVD+RW Video file.

2.3.4 VRMI

VRMI is mandatory and contains Video Recording Manager Information as defined in Chapter 4. It includes information to identify which type of recorder has generated the DVD-Video menus on the disc.

2.3.5 VRM User Data

VRM User Data are optional data structures stored in one or more files, which may be recorded to add functionality or to improve performance on some recorders. The format of these structures is not defined in this specification. The owner of the VRM User Data is the recorder that has generated the DVD-Video menus. When a disc travels from one recorder to another and the menus are regenerated (e.g. after a new recording was made), the original VRM User Data may be deleted or changed.

2.3.6 DVD-Video Zone

Contains DVD-Video-like data structures with modifications as defined in Chapter 3.

2.3.7 VRMI backup

Contains a bit true copy of VRMI for error recovery purposes.

2.3.8 Data Section

The Data Section is intended for storing additional user files in an area of the disc that should not be used by video applications unintentionally. The Data Section can for example be applied to store picture files, meta-data files, audio files, etc. Allocation rules for this area are designed to fit with existing read/write implementations. The format of the user data files is not constrained by this specification. The presence of a Data Section is defined in VRMI.

The Data Section shall start at a 512 kB boundary in the Data Zone. This start location is specified in VRMI (see 4.2).

The last sector of the Data Section coincides with the last sector (logical block) included in the UDF partition.

Note: Video-recording applications should not overwrite any user data in the Data Section without explicit permission of the user.

2.4 File System

2.4.1 General

The volume and file structure on a DVD+RW Video disc are primarily based on the specifications laid down in [8]: *DVD Specifications for Read-Only Disc - Part 2: File System Specifications (Version 1.0, August 1996)*. Within the Data Section specific rules apply, based on UDF 1.02 [21]. This section of the document contains the differences with [8] and information about how the Data Section is treated from a file system point of view.

2.4.2 Mandatory and optional directories and files

A DVD+RW Video volume contains at least a VIDEO_RM directory and a VIDEO_TS directory in the root directory.

The VIDEO_RM directory contains at least the following files:

- VIDEO_RM.DAT (VRM Scratch)
- VIDEO_RM.IFO (VRMI)
- VIDEO_RM.BUP (VRMI backup)

In addition to the mandatory files, the VIDEO_RM directory may contain VRM User Data files of any valid name with 8 bits per character except names starting with "VIDEO_R" (reserved for future use). No other files shall be stored in the VIDEO_RM directory.

The VIDEO_TS directory contains at least the following files:

- VIDEO_TS.IFO (VMGI)
- VIDEO_TS.BUP (VMGI backup)
- VTS_01_0.IFO (VTSI #1)
- VTS_01_1.VOB (VTSTT_VOBS for VTS#1)
- VTS_01_0.BUP (VTSI #1 backup)

If the disc contains a DVD Title Menu (recommended), a file named VIDEO_TS.VOB shall be present in the VIDEO_TS directory. Up to three VTSeS may be recorded.

If two or three VTSeS are recorded also the following files are present in the VIDEO_TS directory:

- VTS_02_0.IFO (VTSI #2)
- VTS_02_1.VOB (VTSTT_VOBS for VTS#2)
- VTS_02_0.BUP (VTSI #2 backup)

If three VTSeS are recorded also the following files are present in the VIDEO_TS directory:

- VTS_03_0.IFO (VTSI #3)
- VTS_03_1.VOB (VTSTT_VOBS for VTS#3)
- VTS_03_0.BUP (VTSI #3 backup)

Additional VTSTT_VOBS file names may be registered in the VIDEO_TS directory:

- VTS_0x_y.VOB (VTS number x is in the range 1,2,3; y = [1..N]; $N \leq 9$)

For all recorded VTSeS the same number of VTSTT_VOBS file names are registered in the file system. VTSTT_VOBS files are not included for VTSeS of which a VTS_0x_0.IFO file has not been included.

The VIDEO_TS directory shall not contain any other files than the ones mentioned in this section.

If in an exceptional case the recorder has been unable to record a file with extension IFO while the corresponding file with extension BUP was successfully recorded, the IFO file's single extent shall be registered with a length of 1 byte and a location that is consistent with the content of the BUP file.

Note: A VTSI backup file contains offsets relative to the start of the VTSI.

2.4.3 Rules for file allocation

All files in the VIDEO_RM and VIDEO_TS directories are recorded with a single extent per file. All other files are recorded in the Data Section and may be recorded with multiple extents per file.

All files with reserved names in the VIDEO_RM and VIDEO_TS directory start at a 32 kB boundary in the Data Zone.

For all VTS_0x_y.VOB file names with the same value for y the same contiguous logical sector space is allocated. In UDF this shall be realised by identifying the same Information Control Block in each of the File Identifier Descriptors of VTS_0x_y.VOB files with the same y. VTSTT_VOBS files are allocated contiguously with increasing value of y.

VTS_0x_y.VOB files with y equal to 1 are located at LSN 004000h or at a multiple of 256 logical blocks after that. The VTS_0x_y.VOB file(s) with the highest value for y, shall end at least 3 MB before the start of the Data Section (if present), or 3 MB before the end of the current Data Zone (otherwise).

Files are allocated in the logical volume with increasing address of first Logical Block in the order as they are listed from top to bottom in Table 2-1.

Table 2-1: File allocation

File name	Size	Content	Comment
VIDEO_RM.DAT	1 MB	VRM Scratch	
VIDEO_RM.IFO	32 kB	VRMI	
.		VRM User Data	Optional. File names starting with "VIDEO_R" reserved.
VIDEO_TS.IFO		VMGI	
VIDEO_TS.VOB		VMGM_VOBS	Optional
VIDEO_TS.BUP		VMGI backup	
VTS_01_0.IFO		VTSl#1	
VTS_02_0.IFO		VTSl#2	Optional.
VTS_03_0.IFO		VTSl#3	Optional.
VTS_01_1.VOB (VTS_02_1.VOB) (VTS_03_1.VOB)	< 1024 MB	1 st part of VTSTT_VOBS	Located at 512 kB boundary \geq LSN 004000h. Up to 3 files sharing the same logical sector space.
VTS_01_2.VOB (VTS_02_2.VOB) (VTS_03_2.VOB)	< 1024 MB	2 nd part of VTSTT_VOBS	Up to 3 files sharing the same logical sector space.
..
VTS_01_9.VOB (VTS_02_9.VOB) (VTS_03_9.VOB)	< 1024 MB	9 th part of VTSTT_VOBS	Up to 3 files sharing the same logical sector space.
VTS_01_0.BUP		VTSl#1 backup	
VTS_02_0.BUP		VTSl#2 backup	Present if VTS_02_0.IFO is present.
VTS_03_0.BUP		VTSl#3 backup	Present if VTS_03_0.IFO is present.
VIDEO_RM.BUP		VRMI backup	
.		Other files	Optional files in the root directory or in other than the VIDEO_RM or VIDEO_TS directory are allocated in the Data Section.

Note: VTSM_VOBS files are not allowed in the DVD+RW Video format.

2.4.4 File System Structures

2.4.4.1 ISO 9660

Only the VIDEO_TS directory, the VIDEO_RM directory and all files in these directories are included in the ISO 9660 structures.

2.4.4.2 UDF Primary Volume Descriptor

The Volume Set Identifier field in the UDF Primary Volume Descriptor shall be updated with a new unique number after modifications have been made to the contents of any of the files in the DVD-Video zone. If the contents of the VRMI files (VIDEO_RM.IFO and VIDEO_RM.BUP) are modified, this Volume Set Identifier shall also be renewed unless only the REC_MODE fields are changed.

2.4.4.3 UDF Partition and Partition Descriptor

If the disc contains a Data Section, the single UDF partition shall have a fixed start address at LSN 000140h and an end address that coincides with the end of the Data Section.

If the disc contains a Data Section, the Flags field of Partition Contents in the Partition Descriptor shall be set to zero. Also, Access Type shall be set to 4 indicating Overwritable and the location and size of the Unallocated Space Bitmap shall be defined in the Partition Header Descriptor in the PD Partition Contents Use field (see also 2.4.4.6).

2.4.4.4 UDF Logical Volume Integrity Descriptor

The UniqueID field of the Logical Volume Header Descriptor in the Logical Volume Contents Use field contains the LVID next UniqueID value. This value shall be higher than the value of the UniqueID field of any File Entry recorded on the logical volume.

If the disc contains a Data Section, File Entries with a UniqueID value less than 256 shall only be used for files or directories outside the Data Section. File Entries for files or directories within the Data Section shall use a UniqueID value of 256 or higher. If no files or directories are present in the Data Section, the value of the LVID next UniqueID shall be 256.

2.4.4.5 UDF Free Space Table

Refer to [20], section 3/10.10.8 and [21], section 2.2.6.2. The Free Space Table field in the Logical Volume Integrity Descriptor shall specify the amount of available space in logical blocks in the Data Section of the single partition. Logical blocks outside the Data Section shall be considered unavailable.

2.4.4.6 UDF Unallocated Space Bitmap (USB)

Refer to [20], section 4/10.1, 4/14.3.2 and 4/14.12. If the disc contains a Data Section, an Unallocated Space Bitmap (USB) shall be recorded as a Space Bitmap Descriptor in the Data Section. Space outside the Data Section is considered fully allocated to the video application and shall be marked as allocated. The length of the extent in which the USB is recorded shall be fixed to $(N / 8) + 24$ rounded up to the nearest multiple of 2048 bytes, where N is the number of available sectors in the Data Zone of the disc.

Note: On a 12 cm DVD+RW disc the number of sectors available for the Data Zone is fixed to 2295104. Consequently the size of the USB is 288768 bytes (141 sectors). On an 8 cm DVD+RW disc there are 714544 sectors available. The resulting size for the USB is 90112 bytes (44 sectors).

2.4.4.7 Location of UDF structures

File Entries with associated extended attributes and allocation descriptors for the following files and directories, as well as the File Identifier Descriptors (FIDs) of the directories, shall be recorded outside the Data Section:

- root directory
- VIDEO_TS directory
- VIDEO_RM directory
- files in VIDEO_TS directory
- files in VIDEO_RM directory

For all other files and directories the above-mentioned UDF structures shall be recorded within the Data Section.

Recommendation: The total amount of space used for the contents of the root directory (FIDs) is recommended not to exceed the size of 1 Logical Block. To comply with this, it is suggested to use compression id 8 for all FID File Identifiers in the root directory and to remove deleted FIDs.

The USB is recorded within the Data Section.

The FSD is recorded outside the Data Section.

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3. Data structures in DVD-Video Zone

3.1 Introduction

The format of the data structures in the DVD_Video Zone are based on [9] *DVD Specifications for Read-Only Disc - Part 3: Video Specifications (Version 1.1, December 1997, including supplemental information up to January 2001)*.

To overcome limitations of the DVD-Video format for read-only discs and to facilitate special features for real-time recording, a number of changes have been made to the data organisation and the rules for the use of some of the recording parameters in the real-time data streams.

In addition to this, the use of Titles and Menus is restricted to improve exchangeability of DVD+RW Video discs between recorders. Also, strict rules are defined for special Titles called Play List Titles, which can be created by the user to define DVD-Video compatible playback sequences of pieces from original recordings.

In the case of a disc that makes use of the VCPS content protection system, it is possible to have an additional navigation structure to allow playback of the VCPS encrypted content and have only non-encrypted data referred to by the DVD-Video navigation structures (see [22]). In the case that the disc uses VCPS, then the restrictions for Titles and Menus and the strict rules for the special Play List Titles apply to the additional VCPS navigation and not the standard DVD-Video navigation structures. When the VCPS navigation is used the restrictions for Titles and Menus and the rules for the Play List Titles do not apply to the DVD-Video titles, however it is recommended that the recorder use a similar menu system for both the DVD-Video and VCPS navigations.

3.2 Data Organisation

3.2.1 General

The DVD-Video Zone contains up to three Video Title Sets with different video coding modes. Three different video coding modes are supported (see Table 3-1).

Table 3-1: Supported video coding modes

Video coding mode	horizontal size (pixels)	vertical size (pixels)	
		if TV system is 525/60	if TV system is 625/50
MPEG-1	352	240	288
MPEG-2, "Half D1"	352	480	576
MPEG-2, D1	720	480	576

The TV system video attributes in VMGI and VTSI shall be identical for all VTSeS on a disc.

The rules for the allocation of DVD-Video data structures in the DVD-Video Zone are different from those defined in [9]. The Video Objects for all Titles on the disc are put into a single VTS Title Video Object Set irrespective of the VTS they belong to. VTSI files for all VTSeS are put in front of this VOBS with increasing VTS number. The VTSI backup files are put after the VOBS in the same order as the VTSI files. An example of a DVD-Video Zone with 3 Titles in 2 VTSeS is shown in Figure 2. The VTS Title VOBS start position is fixed at the moment the first recording is made and is chosen such that it allows the data structures in front of this VOBS to become bigger when new recordings are made. See also 2.4.3.

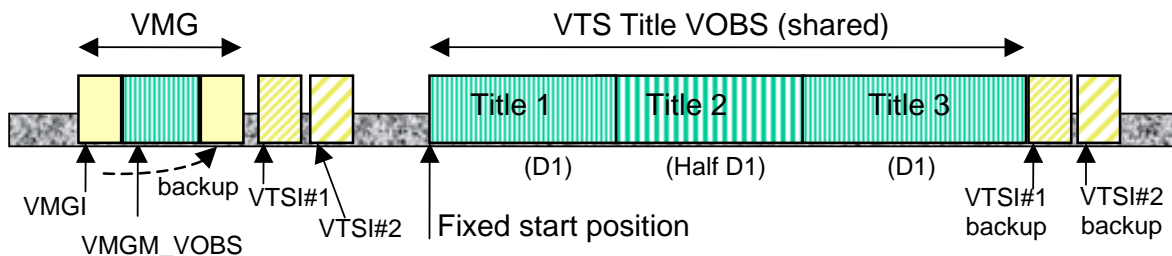


Figure 2: Example of DVD-Video Zone

3.2.2 Video Manager (VMG) and Video Title Sets (VTS)

The Video Manager consists of VMGI, VMGM_VOBS (optional) and a backup of VMGI.

The disc contains up to three Video Title Sets. No more than one VTS shall contain video Titles with Video compression mode set to MPEG-1. No more than two VTSES shall contain video Titles with Video compression mode set to MPEG-2. In the case that there are two VTSES with Video compression mode set to MPEG-2, one VTS shall have a horizontal source picture resolution set to 720 pixels on a line and the other VTS shall have a horizontal source picture resolution set to 352 pixels on a line.

VTSES are not allowed to contain a VTSM_VOBS, which means that there are no Video Objects available for any VTS menus. See also section 3.2.8.1.

There is only one VTSTT_VOBS on the disc containing the Video Objects for all VTSES.

3.2.3 Video Object Set, VOBs and Cells

A Video Object Set (VOBS) is a collection of Video Objects (VOBs). VOBs that are used for the menus are stored in the Video Manager VOBS (VMGM_VOBS). VOBs that are used for the Titles are stored in the VTS Title VOBS (VTSTT_VOBS).

3.2.3.1 Video Manager VOBS

The VMGM_VOBS fully complies with [9], with one exception: A sequence of logical blocks may have been recorded immediately before or after each VOB with data that does not belong to any VOB in the VOBS.

3.2.3.2 VTS Title VOBS

A Video Object in the VTSTT_VOBS is (a part of) a sequence of contiguously recorded Cells, together constituting (a part of) an MPEG-2 Program Stream as defined in [3]. An integer number of MPEG-2 Program Stream packs may be missing from the beginning of the first Cell of the VOB, if this Cell is not used by any Title. The last Cell of a VOB is a Buffer Cell that is not used by any Title. An integer number of MPEG-2 Program Stream packs may be missing from the end of the Buffer Cell. At least the first NV_PCK of the Buffer Cell shall be included at the end of a VOB.

The SCR-base of any pack in a VOB shall be in the range from 0 to VOB_V_E_PTM (see 3.3.7.2.2). The SCR of a pack is only allowed to be zero if this pack is the first pack of both a VOB and a Cell. In this case the first video frame in the VOB (in display order) starts with a top field. The DVD-Video rules for the insertion of the P-STD_buffer parameters in the PES packet headers shall be followed for the first VOB of such a VOB. P-STD_parameters shall never appear in any packet header after the first VOB.

If the SCR of the first pack of a Cell is not equal to zero, SCR-base shall not be smaller than 36000. In this case the P-STD_buffer parameters are not inserted in any packet header in the VOB.

Note: SCR-base consists of the 33 most significant bits of the SCR in the pack header.

Each VOB of a Cell that is used by a Full Title shall contain at least one coded video frame.

According to the DVD-Video specifications a VOB may also contain up to eight Audio streams (in elementary Audio streams and/or in Private streams). The DVD+RW Video format allows the use of the same eight Audio stream numbers, but only up to two of the streams will be available for the user simultaneously. See 3.2.7 for details.

In DVD-Video up to 32 Sub-picture streams are available. In DVD+RW Video only one Sub-picture stream is used within the same VOB.

The maximum presentation period of a Cell is restricted. In the case of constant bitrate recording (CBR) and in the case of constrained variable bitrate recording (CVBR) the following formula applies:

$$T_{cp} \leq \Delta SCR / 1450$$

with:

T_{cp} : Cell presentation period in seconds

ΔSCR : In the CBR case: difference between the SCR of two consecutive packs

In the CVBR case: ΔSCR of a CBR stream at the same Bitrate Level

See Annex B for more information on CBR, CVBR and ΔSCR .

If the bitrate mode is different from CBR and CVBR, the maximum permitted presentation period of a Cell is 255.6 seconds.

The VTSTT_VOBS on a DVD+RW Video disc is not fully compliant with [9]. The following exceptions apply:

1. A sequence of logical blocks may have been recorded immediately before or after each VOB with data that does not belong to any VOB in the VOBS.
2. The DVD-Video specification demands that a VOB starts with an SCR equal to zero. As on a rewritable disc the beginning of a VOB could have been overwritten, this rule does not apply for DVD+RW Video discs.
3. The DVD-Video specification demands that the Display of the video stream from the beginning of a VOB has to start with a top field and has to end with a bottom field. Because of the possibility to overwrite parts of original recordings, this rule no longer holds. Alternative rules have been created to guarantee play back on legacy devices.
4. The DVD-Video specification prescribes incremental numbering of VOBS and Cells. When recording the disc for the first time that requirement can generally be met. However, when old recordings are (partly) overwritten, or when the user has edited existing recordings, it may not be possible to maintain the incremental numbering. To overcome this problem, DVD+RW Video format requires that the VOB ID number of all VOBS is equal to '1'. In addition to this, Cell ID numbers (except number 255) remain unique but they are allowed to be non-sequential.
5. VOBS and Cells contain Navigation packs with forward references to facilitate forward search. Some of these forward references cannot be known at recording time and therefore must be encoded with values which make legacy playback devices behave in an acceptable way.
6. The Navigation packs also contain a parameter specifying the presentation termination time of the last video frame of the VOB. This parameter cannot be made correct in real time in all cases. To solve this problem a high number will be recorded for this parameter. A Buffer Cell (which may be incomplete) at the end of a VOB guarantees that the end of a VOB is never reached during play back.

3.2.4 Recordings

A Recording is a contiguous piece of the VTS Title VOBS, enclosing an integer number of Logical Blocks. The VTSTT_VOBS is partitioned into a maximum of 49 adjacent Recordings. The first LB of the first Recording is the first LB of the VTSTT_VOBS. The address of the last LB of each Recording is indicated in the VRMI (see 4.4). The last Recording is optionally followed by other data, e.g. unused remnants of (a) previous Recording(s) that might have been deleted from the VTSTT_VOBS. Each Recording delimits the scope of a Full Title.

Recordings do not necessarily coincide with the VOBs within the VTSTT_VOBS, although this will often be the case. Each Logical Block of the VTSTT_VOBS is part of exactly one Recording (unless it is located after the last Recording) and may be included in one of the VOBs. This is illustrated by an example in Figure 3.

Recordings may be “deleted” by the user by making them inaccessible via the Program Chains. If two or more consecutive Recordings are deleted, it is recommended to combine them into one “Deleted Recording”. If the last Recording is deleted, it is either deleted from the VTSTT_VOBS file(s), it becomes part of the optional data after the last Recording that is not deleted, or it becomes a Deleted Recording (not recommended).

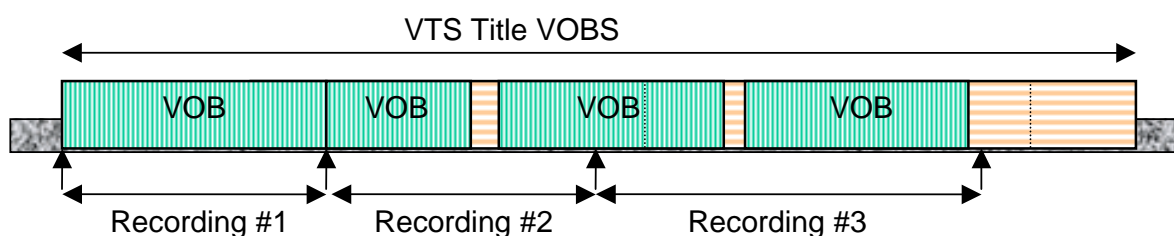


Figure 3: Example of VTSTT_VOBS with 4 VOBs and 3 Recordings

3.2.5 Full Titles and Play List Titles

For each Recording two One_Sequential_PGC_Titles are present: one Full Title and one Play List Title.

The Full Title defines play back of complete Cells (but not the Buffer Cell) of a Recording in the order of allocation in the VOBS.

The Play List Title may be different from the Full Title. It defines play back of all, a subset or none of the Cells available in the Recording. The same Cell may be referred to more than once in a Play List Title and Cells may be played in any order. An empty Play List Title plays none of the Cells of the Recording.

Each Full Title and each Play List Title is represented by a Title Search Pointer in the Title Search Pointer Table in VMGI and by a Title Unit (TTU) in the Part_of_Title Search Pointer Table in the VTSI. There is a different PGC for each Title. When the additional VCPS structures exist, then the VCPS_TT_SRPT and VCPS_VTS_PTT_SRPT are used to represent each Full Title and Play List Title. If these structures do not exist, then the TT_SRPT and VTS_PTT_SRPT are used.

The number of Full Titles (including Free Space Titles) on a DVD+RW Video disc is equal to the number of Play List Titles with a maximum of 49.

3.2.6 Real Titles and Free Space Titles

Full Titles and Play List Titles are Real Titles unless they are tagged as Free Space.

When a Recording is deleted by the user, both the Full Title and the Play List Title in the (VCPS_)TT_SRPT¹ are tagged as Free Space by setting a unique Playback Type value (see 3.3.2.2).

If the following criteria are true, one additional Play List Title and one additional Full Title that are both tagged as Free Space Titles (but not related to a Deleted Recording) are added in the TT_SRPT:

- the number of Recordings is smaller than 49
- there is at least 4 MB available on the disc for a new Recording after the last one

The Program Chain related to a Free Space Title shall be an Empty PGC.

Titles can be sub-divided into Chapters (Part_of_Titles). See section 3.3.3.2 for more information.

¹ VCPS_TT_SRPT if the additional VCPS structures are present, otherwise TT_SPRT

3.2.7 Audio

In many situations only one encoded Audio stream will be recorded together with the video, using the same Audio coding mode for all recordings. In that case, audio would be recorded in the Audio stream with Decoding Audio stream number '0' and there would be only one "Audio stream attribute" defined in the VTSI.

Besides the fact that the DVD+RW Video specification allows for two simultaneous Audio streams, also the following cases can be handled:

- Some Titles are encoded with one set of Audio stream attributes (e.g. MPEG-1), other Titles are encoded with another set of Audio stream attributes (e.g. AC-3) within the same VTS.
- Some Titles have a second Audio stream, some don't, some have no audio (within the same VTS).

To enable the above cases in DVD+RW Video, some of the rules that apply for DVD-Video have been relaxed:

1. The VTS_AST_ATRT field in VTSI specifies which Audio stream attribute settings *may be* used in a Title. The actual number of recorded Audio streams *may be less* than the number of recorded VTS_AST_ATR fields. See also 3.3.3.1.3.
2. The Availability flag of the PGC_AST_CTL fields in each PGCI defines which streams are available in a Title. In DVD+RW Video there is *no requirement* that the flags are equal in all Title PGCs in the same VTS. See also 3.3.4.1. Together with the first point this allows for the use of different Audio stream attributes in different Titles within the same VTS.

In addition to the audio modes defined by [9], DVD+RW Video allows for transparent recording of digital audio from an IEC-60958 input. A special pack type has been defined for this purpose. See section 3.4.3. DVD-Video players ignore IEC-60958 audio streams.

3.2.8 Navigation

3.2.8.1 Menus

On a pre-recorded DVD-Video disc the Title Menu is usually available for easy access to Titles. Video recorders may create their own Title Menus on DVD+RW Video discs. The recorder itself determines the look and feel of such a menu. The recorder can e.g. include program names and recording dates in the menu. When the content of the disc changes, the Title Menu needs to be updated. However, text information about the recorded program cannot easily be retrieved from the previous version of the pixel based and partly MPEG encoded menu. Therefore recorders are required to create and maintain the Video Recording Manager Information file (see Chapter 4).

The following general rules apply for menus:

- The Entry PGC of the Title Menu shall exist. If no Real Titles are present on the disc ("empty" disc), UOP[10..16] shall be blocked for the Title Menu PGC.
- The Entry PGC of the Root Menu shall exist in each VTSI. However, this PGC is a dummy PGC. UOP[10..16] shall be blocked for all VTS Menu PGCs.
- Entry PGCs for Sub-picture Menu, Audio Menu, Angle Menu and PTT Menu shall not exist.

If a menu is recorded, the following rules apply:

- The Title Menu shall provide access to all non-empty Real Play List Titles. Other Titles may be accessible via the Title Menu.
- It is recommended that the FP_PGC contains a JumpSS to the Title Menu.

If no menu is recorded, the following rule applies:

- The Entry PGC of the Title Menu is a dummy PGC.

The menu layout is basically free. However, the speed of regeneration of the menu (e.g. after a new recording has been made) can be improved when certain properties of the original menu structures are known. For that reason a menu profile may be identified by means of the MENU_LO_ID parameter in the VRMI. See also Annex C.

3.2.8.2 Title Linking

The playback order of Titles is controlled by dedicated PGCs in the VMGI. The following rules shall be applied:

1. Each Title PGC contains a call to PGC#2 of the VMGM.
2. PGC#2 in the Video Manager is the so-called Next Title PGC, which contains a jump list to the Title to be played next (see 3.3.2.3). If necessary, PGC#3 is used as an extension of the Next Title PGC. UOP[10..16] shall be blocked for PGC#2 and PGC#3 of the VMGM.

3.2.9 Editing

The result of any editing conforms to the format specified in this document.

3.3 Restrictions and modifications compared to the read-only format

3.3.1 General

Parental management is not applied.

3.3.2 VMGI

The maximum size of VMGM_PGCI_UT is 18 kB.

The Text Data Manager is optional. The maximum size of TXTDT_MG is 2 kB. It is recommended that recorders keep the contents of TXTDT_MG consistent with the contents of VRMI.

The maximum number of Cells in the VMGM_C_ADT is 170.

The maximum number of VOBUs in VMGM_VOBU_ADMAP is 511.

Table 3-2 shows an overview of the structure and size of VMGI.

Table 3-2: VMGI structure and size

	Minimum size (sectors)	Maximum size (sectors)	Comment
VMGI_MAT	1	1	Fixed Size
TT_SRPT	1	1	
VMGM_PGCI_UT	1	9	DVD+RW Video restriction: 9 sectors maximum
PTL_MAiT	-	-	Prohibited in DVD+RW Video
VTs_ATRT	1	2	2 sectors in case of 3 VTsEs
TXTDT_MG	-	1	Optional
VMGM_C_ADT	-	1	DVD+RW Video restriction: maximum 170 Cells
VMGM_VOBU_ADMAP	-	1	DVD+RW Video restriction: maximum 511 VOBUs
VCPS_TT_SRPT	-	1	
VCPS_VMGM_PGCI_UT	-	9	DVD+RW Video restriction: 9 sectors maximum
VCPS_PTL_MAiT	-	-	Prohibited in DVD+RW Video
VCPS_TXTDT_MG	-	1	Optional
TOTAL	4	27	

3.3.2.1 VMGI_MAT

VERN shall be either (10h) or (11h) according to DVD-Video rules.

All bits of VMG_CAT shall contain the value 0b, indicating that the disc is multi-region.

The Adapted disc type field of ADP_ID shall be set to (01b) indicating that the video format is adapted for recording on a recordable or rewritable medium.

VTs_Ns contains a value in the range [1..3].

The first 8 bytes of PVR_ID contain the string 'DVD-VR01'.

Note: This string is unmodified from previous versions of the DVD+RW Video specification as there are no changes to the VMGI specification.

If a menu is recorded it is recommended that the FP_PGC contains a link to the Title Menu by means of a JumpSS with Domain_ID equal to 01b and Menu_ID equal to (0010b).

3.3.2.2 TT_SRPT

The Title Search Pointer Table consists of two sections of equal length. The first half contains pointers for N Play List Titles and the second half contains pointers to N Full Titles. Play List Titles as well as Full Titles are sorted in the order of incrementing start addresses of the related Recordings.

The maximum number of Chapters (Part_of_Titles) per Title is 99. The maximum number of Chapters in all Full Titles on the disc is 254.

TT_PB_TY for a Title is shown in Table 3-3.

Table 3-3: TT_PB_TY settings in TT_SRP

Bit	Name	Value	Comment
b7		0b	reserved
b6	TT_TY	0b	All Titles are One_Sequential_PGC_Titles.
b5	TT_PB_TY1	0b	No Link/Jump/Call instruction as a Cell Command or Button Command in any Title.
b4	TT_PB_TY2	1b	All Titles contain a Link/Jump/Call instruction as a Pre- or Post-Command.
b3	TT_PB_TY3	0b	No Link/Jump/Call instruction as a Button Command in any Title.
b2	TT_PB_TY4	1b	All Titles contain a Link/Jump/Call instruction in the Title Domain.
b1	UOP 1	0b	PTT_Play() and PTT_Search() shall not be blocked for Real Titles.
		1b	PTT_Play() and PTT_Search() shall be blocked for Free Space Titles. See Note 1.
b0	UOP 0	1b	Time_Play() and Time_Search() not possible by using VTS_TMAPT. See Note 2.

Note 1: The UOP 1 bit in TT_PB_TY may be used to identify whether a Title is a Real Title or a Free Space Title. This bit is set to (0b) for all Real Titles, including empty Play List Titles.

Note 2: The sole purpose of setting the UOP 0 bit to (1b) is to allow that TMU in VTS_TMAP is set to (00h). Although VTS_TMAP on a DVD+RW Video disc is empty (see also 3.3.3.5) and setting UOP 0 to (1b) will block Time_Play() and Time_Search() functions on legacy DVD-Video players, performing these functions on DVD+RW Video Titles is not prohibited.

3.3.2.3 VMGM_PGCI_UT

3.3.2.3.1 General

There shall be only one VMGM Language Unit (VMGM_LU_Ns = 1). The search pointer for this Language Unit shall indicate that the Entry PGC of the Title Menu exists in this Language Unit.

The VMGM_LU contains at least 3 search pointers:

1. VMGM_PGCI Search Pointer #1 points to the Entry PGC for the Title Menu
2. VMGM_PGCI Search Pointer #2 points to the Next Title PGC (see also 3.2.8.2)
3. VMGM_PGCI Search Pointer #3 points to the Next Title Extension PGC.

3.3.2.3.2 Next Title PGC and Next Title Extension PGC

The Next Title PGC and the Next Title Extension PGC are dummy PGCs, which together act as a jump table after a certain Title has been played. The PGC_CMDT of both PGCs contains no Post-Commands and no Cell Commands. The number of Pre-Commands and whether the Next Title Extension PGC is used, depends on the number of Titles on the disc and the implementation by the recorder. The Next Title Extension PGC shall be recorded, even if it is not used.

The first six General Parameters GPRM(0) up to and including GPRM(5) may be used for the purpose of Title linking. Their contents may be changed anywhere on the disc with the exception of Cell

Commands and Button Commands. They are not allowed to be put into Counter mode anywhere on the disc.

3.3.3 VTSI

As there are no VTS Menu VOBs, VTSM_C_ADT and VTSM_VOBU_ADMAP do not exist.

Table 3-4 shows the structure of the VTSI on a DVD+RW Video disc and indicates the minimum and maximum size.

Table 3-4: Structure and size of VTSI

	Minimum size (sectors)	Maximum size (sectors)	Comment
VTSM_MAT	1	1	Fixed size
VTSM_PTT_SRPT	1	2	
VTSM_PGCIT	1	25	
VTSM_PGCI_UT	1	3	Maximum size of VTSM_PGCIT and VTSM_PGCI_UT together shall not exceed 26 sectors
VTSM_TMAPT	1	1	Does not contain any entries
VTSM_C_ADT	-	-	Prohibited in DVD+RW Video
VTSM_VOBU_ADMAP	-	-	Prohibited in DVD+RW Video
VTSM_C_ADT	2	2	Fixed size in DVD+RW Video
VTSM_VOBU_ADMAP	1	80	Maximum 40959 VOBUs
VCPS_VTS_PTT_SRPT	-	2	
VCPS_VTS_PGCIT	-	25	
VCPS_VTSM_PGCI_UT	-	3	Maximum size of VCPS_VTS_PGCIT and VCPS_VTSM_PGCI_UT together shall not exceed 26 sectors
VCPS_VTS_TMAPT	-	1	Does not contain any entries
TOTAL	8	141	

3.3.3.1 VTSI Management Table (VTSM_MAT)

VERN shall be either (10h) or (11h) according to DVD-Video rules.

For all VTSI files VTSTT_VOBS_SA points to the same sector, which is the first sector of the single VTSTT_VOBS.

Note: VTSTT_VOBS_SA is different in the VTSI for each VTS, as the first sector of the VTSI that contains this pointer is the reference address (first LB of the VTS) for this field.

3.3.3.1.1 VTS Video Attributes (VTS_V_ATR)

See section 3.2 for allowed combinations of VTSes with different settings for Video compression mode and Source picture resolutions on one disc.

Aspect ratio indicates 4:3.

Line21_switch_1 and Line21_switch_2 are both set to (1b) in the case of 525/60 TV system and set to (0b) in the case of 625/50 TV system.

Note: If there is no Line21 data available from the recording source in the case of 525/60 TV system, dummy Line21 data shall be put in the recorded video stream.

Source picture resolution is 720x480, 352x480 or 352x240 in the case of 525/60 TV system. Source picture resolution is 720x576, 352x576 or 352x288 in the case of 625/50 TV system. See also 3.2.

Source picture letterboxed field indicates "not letterboxed".

Film camera mode field indicates "camera mode".

Aspect ratio, Source picture letterboxed and Film camera mode can be overruled by real-time attributes (see 3.4.1).

3.3.3.1.2 Number of Audio Streams (VTS_AST_Ns)

Describes the number of Audio stream attribute sets used in this VTS.

Note: The number of actually recorded streams in the VTSTT_VOBS may be less and may change within a VOB.

3.3.3.1.3 VTS Audio Stream Attribute Table (VTS_AST_ATRT)

This table lists the different Audio stream attribute sets that are defined (and may or may not be used) for this VTS. The PGCI for each Title defines which of the sets is or are actually used.

When seven or eight of these sets are defined, at least the following two sets shall be among the defined sets:

(02C1 0000 0000 0000h)	2 channel Dolby AC-3
(4201 0000 0000 0000h)	2 channel MPEG-1 Audio

Note: It is recommended that recorders support at least one of the above sets for recording from analogue sources.

Audio type is not specified (00b).

Audio application mode is set to Surround mode (10b).

Application information is set to (0000 0000b) or (0000 1000b), but the Surround type bits of this field (b2 and b3) can be overruled by real-time attribute information (see 3.4.1).

3.3.3.1.4 Number of Sub-picture Streams (VTS_SPST_Ns)

The number of Sub-picture streams in this VTS is set to one.

Note: The actual number of Sub-picture streams recorded in the VTSTT_VOBS is zero or one.

3.3.3.1.5 VTS Sub-picture Stream Attribute Table (VTS_SPST_ATRT)

All fields in this table are zero.

3.3.3.2 VTS PTT Search Pointer Table (VTS_PTT_SRPT)

The number of Title Units (VTS_TTU_Ns) is twice the number of Full Titles recorded in this VTS.

Title Units for the Play List Titles are recorded before the Title Units for Full Titles. Within this constraint they may be recorded in any order.

As all Titles are One_Sequential_PGC_Titles, all Program Chain numbers (PGCN) within the same TTU are identical and the Program Numbers (PGN) are equal to the Chapter number. In the case that the Title is a Free Space Title, the PGN shall be 1 (see section 3.3.3.3).

3.3.3.3 VTS Program Chain Information Table (VTS_PGCIT)

The number of VTS_PGCI Search Pointers is equal to the number of Title Units in this VTSI. The search pointers are recorded in the same order as the Title Units.

All PGCs are Entry PGCs with all bits zero for Block mode, Block type and PTL_ID_FLD. All VTS_PGCI_SA values in VTS_PGCIT shall be different.

The VTS_PGCI Search Pointer of a Free Space Title points to a PGCI for an Empty PGC.

3.3.3.4 VTSM Program Chain Information Unit Table (VTSM_PGCI_UT)

The number of VTS Menu Language Units as specified in VTSM_PGCI_UTI shall be 1.

There is exactly one VTSM_LU_SRP. VTSM_EXST shall contain the value (1000 0000b) to indicate that just the Root Menu exists.

The VTSM Language Unit contains one or more VTSM_PGCI_SRP. The VTSM_PGC_CAT parameter for the first VTSM_PGC contains the value (8300 0000h) indicating that the associated PGC is the Entry PGC for the Root Menu.

There is at least one VTSM_PGCI (see also 3.2.8.1).

3.3.3.5 VTS Time Map Table (VTS_TMAPT)

The VTS_TMAPs are present for all Titles on the disc but do not contain any map entries: TMU shall be set to (00h).

Note: UOP 0 is set to (1b) for all Titles, indicating that Time_Search() and Time_Play() is not possible by using VTS_TMAPT.

3.3.3.6 VTS Cell Address Table (VTS_C_ADT)

The VTS_VOB_Ns parameter contains the value '1'.

Note: VTS_VOB_Ns does not reflect the actual number of VOBs in the VTSTT_VOBS of a DVD+RW Video disc. It is set to '1' as the VOB ID number of all VOBs is set to '1'.

All VTS_CPI have the same value ('1') for VTS_VOB_IDN. Exactly 254 VTS_CPI blocks are recorded with VTS_C_IDN starting from '1' and incrementing up to and including '254'.

VTS_CP_SA and VTS_CP_EA of Cell Pieces that are not referenced in this VTSI by any Full Title PGC contain the value (0000 0000h).

It is not allowed to use the same Cell ID number in VTS_CPI of more than one VTS with VTS_CP_SA and VTS_CP_EA different from (0000 0000h).

3.3.3.7 VTS VOB Address Map (VTS_VOB_ADMAP)

The VOB start addresses of all VOBs that are included in the presentation of any Full Title PGC on the disc are listed in ascending order in the VTS_VOB_ADMAP.

Note: VTS_VOB_ADMAP is identical for all VTSes in the DVD-Video Zone.

Note: VOB start addresses of VOBs that are part of Deleted Recordings are not included in the VTS VOB Address Map. On a disc with just a deleted recording (empty disc) the VTS_VOB_ADMAP is empty and VTS_VOB_ADMAP_EA is equal to (0000 0003h).

3.3.4 Program Chain Information (PGCI) for Real Title PGCs

3.3.4.1 PGC General Information (PGC_GI)

Up to two of the Availability flags in the PGC_AST_CTLT shall be set to (1b). The PGC_AST_CTLT of a Play List Title shall be identical to the PGC_AST_CTLT of the related Full Title, unless the PGC for the Play List Title is an Empty PGC. Each VOB of a Cell that is referred to by the PGC shall contain (an) Audio packet(s) of each Decoding Audio Stream for which the corresponding Audio stream has an Availability flag set to (1b).

The Availability flag of the first PGC_SPST_CTL field in the PGC_SPST_CTLT is set to (1b). All other bits of the PGC_SPST_CTLT contain the value (0b).

PG Playback mode in PGC_NV_CTL is set to sequential playback. The Still time value is set to "no Still".

The PGC_SP_PLT in the PGC for the Play List Title shall be identical to the PGC_SP_PLT in the PGC for the related Full Title, unless the PGC for the Play List Title is an Empty PGC.

3.3.4.2 PGC Command Table (PGC_CMDT)

The PGC Command Table contains at least one and a maximum of 128 commands. An average below five commands is recommended. If the VERN field in VRMI_GI is set to (0010h) then the number of commands must be 3.

At least one of the commands is a Post-Command. The last Post-Command is a CallSS with Domain ID set to (11b) and VMGM_PGCN = 2.

3.3.4.3 Cell Playback Information Table (C_PBIT)

Cells are not part of an Angle Block and do not exist in an Interleaved Block.

A maximum value for the Cell Playback Time (C_PBTM) is defined in section 3.2.3.

The seamless playback flag shall not be set to (1b), if the previous Cell is not in the same VOB as the current Cell.

3.3.4.4 Cell Position Information Table (C_POSIT)

VOB_IDN of all Cells in the PGC contain the value '1'.

Note: On DVD+RW Video discs, all VOBs have the same VOB_IDN.

It is allowed that the Cell ID number of a Cell of which the Seamless playback flag set in Cell Playback Information, is not the same as the previous Cell ID number incremented by 1.

3.3.5 PGCI for Empty PGCs

The content of a PGCI for Empty PGCs is defined in Table 3-5.

Table 3-5: PGCI for Empty PGC

Structure	Item	Contents	Comments
PGC_GI	PGC_CNT	0000 0101h	There is 1 Program and 1 Cell.
	PGC_PB_TM	0000 0140h 0000 01C0h	... if TV system is 625/25 ... if TV system is 525/30
	PGC_UOP_CTL	0000000x xxxxxxx1 111111xx xxx0xxxxb	Menu_Call() and Resume() shall be disabled.
	PGC_AST_CTLT	1 st byte: 80h other bytes: 00h	
	PGC_SPST_CTLT	1 st byte: 80h other bytes: 00h	
	PGC_NV_CTL	all bytes: 00h	
	PGC_SP_PLT	16 x (007F 7F7Fh)	
	PGC_CMDT_SA	00ECh	
	PGC_PGMAP_SA	010Ch	
	C_PBIT_SA	010Eh	
	C_POSIT_SA	0126h	
PGC_CMDT	PRE_CMD_Ns	'2'	
	POST_CMD_Ns	'1'	
	C_CMDs	'0'	
	PGC_CMDT_EA	1Fh	
	PRE_CMD#1	any valid Navigation Command	Recorder's freedom
	PRE_CMD#2	3008 0002 01C0 0000h	CallSS(VMGM_PGCN = 2, CN for RSM information = 1, Domain ID = 3, Menu ID = 0)
	POST_CMD	3008 0002 01C0 0000h	CallSS(VMGM_PGCN = 2, CN for RSM information = 1, Domain ID = 3, Menu ID = 0)
PGC_PGMAP	General		There is just one Program. Size is 2 bytes.
	EN_CN + padding byte	0100h	
C_PBIT	General		There is just one C_PBI. Size is 24 bytes.
	C_CAT	0000 0000h	
	C_PBTM	0000 0140h 0000 01C0h	... if TV system is 625/25 ... if TV system is 525/30
	C_FVOBU_SA	0000 0000h	These are just dummy addresses.
	C_FILVU_EA	0000 0000h	There is no defined relation with the actual data on these locations.
	C_LVOBU_SA	0000 xxxxh	'x' is don't care, but C_LVOBU_EA shall be greater than C_LVOBU_SA.
	C_LVOBU_EA	0000 xxxxh	
C_POSIT	General		There is just one C_POSI. Size is 4 bytes.
	C_VOB_IDN	'1'	
	C_IDN	'255'	Cell does not really exist

3.3.6 Presentation Control Information (PCI) in VTSTT_VOBS

NV_PCK_LBN in PCI_GI contains the address of the NV_PCK in which the PCI is included with RLBN from the first LB of the single VTSTT_VOBS on the disc.

Note: Modification of a Play List Title may require that a Cell be split into two new Cells. In that case all values of Cell Elapse Time (C_ELTM in PCI_GI) shall be updated in all PCI fields in the second Cell.

Additional data fields for carrying real-time stream attributes are defined in section 3.4.1.

3.3.7 Data Search Information (DSI) in VTSTT_VOBS

NV_PCK_LBN in DSI_GI contains the address of the NV_PCK in which the DSI is included with RLBN from the first LB of the single VTSTT_VOBS on the disc.

The Adapted disc type field in VOBU_ADP_ID shall be set to (01b).

Note: All VOBs are allocated in Contiguous Blocks and there are no Angles.

3.3.7.1 DSI General Information (DSI_GI)

The VOB ID number is always '1'.

There is no requirement that the Cell ID numbers are monotonically increasing from 1 in the Video Object.

The following rules shall be applied for Cell ID:

- Cell ID is identical in all VOBUs belonging to the same Cell
- Cells which are used by Real Titles have a Cell ID in the range [1..254] and are uniquely identified by their Cell ID, irrespective of the VTS that the Title belongs to
- Buffer Cells may have Cell ID number 255 or any other Cell ID as long as it is different from the ID of the preceding Cell

Note: Modification of a Play List Title may require that a Cell be split into two new Cells. In that case all values of Cell Elapse Time (C_ELTM in DSI_GI) and the Cell ID number (VOBU_C_IDN) shall be updated in all DSI fields in the second Cell.

3.3.7.2 Seamless Playback Information (SML_PBI)

3.3.7.2.1 VOB_V_S_PTM

If the SCR of the first pack of the VOB is zero, VOB_V_S_PTM contains the presentation start time of the first video frame (in display order) in the VOB. In this case video presentation at the beginning of the VOB starts with a top field.

If the SCR of the first pack of the VOB is not equal to zero, VOB_V_S_PTM contains a value which is smaller than the VOBU_S_PTM of the first Cell in the VOB and may be smaller than the SCR-base of the first pack in the VOB. VOB_V_S_PTM shall be a value on the presentation start time grid of the top fields of video frames in the VOB.

In any case the value of VOB_V_S_PTM is expressed in units of 1/90000 seconds and shall be less than (20000h).

It is recommended that when a DVD+RW Video recorder creates a new VOB, the SCR of the first pack of this VOB is equal to zero. In case the start of a VOB is overwritten by a new recording, VOB_V_S_PTM in the NV_PCKs of the remaining part of the VOB don't need to be updated.

3.3.7.2.2 VOB_V_E_PTM

VOB_V_E_PTM is equal to the sum of VOB_V_S_PTM and 2^{20} video frame presentation periods.

Note: If the TV system in VTS_V_ATR in VTSI is set to 525/60, VOB_V_E_PTM is equal to the sum of VOB_V_S_PTM and (BBB0 0000h). If the TV system in VTS_V_ATR in VTSI is set to 625/50, VOB_V_E_PTM is equal to the sum of VOB_V_S_PTM and (E100 0000h).

3.3.7.3 VOB Search Information (VOBU_SRI)

The forward pointers FWDI with indexes up to 6 shall follow the rules of DVD-Video. The forward pointers FWDI with indexes in the range [7..10] shall contain the same value as FWDI 6. The forward pointers with indexes in the range [11..240] shall contain the value (3FFF FFFFh).

3.3.8 Video Objects in VTSTT_VOBS

See 3.2.3.

Note: Seamless connections between VOBs are excluded.

Only one Sub-picture stream is allowed within a VOB. The Sub-picture decoding stream number is '0'. Data for a Sub-picture Unit (SPU) is fully contained in one VOB. The PTS of the first Sub-picture packet in a VOB (indicating the start of the SPU validity period) shall be greater than or equal to the Start PTM and smaller than the End PTM of this VOB. The SPU shall not contain Display Control Commands with an execution start time greater than the End PTM of the VOB containing the SPU.

It is recommended that an SPU be repeated every VOB until the end of the intended display period. The last occurrence of the SPU could then contain a STP_DSP command to indicate the end of the display period of the Sub-picture.

3.4 Additions to the read-only format

3.4.1 PCI_GI Extension

The last 32 bytes of PCI_GI may contain PCI_GI Extension data, for data contained in the VTS Title VOBS. The 32 reserved bytes at the end of PCI_GI as defined in the DVD-Video specification are redefined for DVD+RW Video as shown in Table 3-6.

Table 3-6: Redefinition of reserved fields at end of PCI_GI

	Contents	Number of bytes
reserved	reserved	4 bytes
(8) PCI_GI_XI	PCI_GI Extension Information	1 byte
(9) CHNG_FLD	Change Field	1 byte
(10) RT_ATR_1	Real-Time Attributes 1	2 bytes
(11) RT_ATR_2	Real-Time Attributes 2	2 bytes
(12) REC_DATE_1	Recording Date 1	4 bytes
(13) REC_TIME_1	Recording Time 1	4 bytes
(14) REC_DATE_2	Recording Date 2	4 bytes
(15) REC_TIME_2	Recording Time 2	4 bytes
reserved	reserved	6 bytes
	Total	32 bytes

(8) PCI_GI_XI

Indicates which of the PCI_GI Extension fields are recorded. If all bits in this byte are zero, the remaining bytes of PCI_GI following this field are zero.

b7	b6	b5	b4	b3	b2	b1	b0
RTA Validity		Rec Info Validity		Reserved			

RTA Validity

- ... Defines the validity of Real-Time Attributes in this PCI_GI Extension.
- 00b : No Real-Time Attributes available, default values apply
 - 01b : Not allowed
 - 10b : RT_ATR_1 specifies Real-Time Attributes for the whole VOB
 - 11b : RT_ATR_1 specifies Real-Time Attributes from the Start PTM of this VOB up to (but not including) the Change Field, RT_ATR_2 specifies Real-Time Attributes for the remaining part of the VOB.

Rec Info Validity

- ... Defines the validity of Recording Date and Time info in this PCI_GI Extension.
- 00b : No Recording Date and Time information available
 - 01b : Not allowed
 - 10b : REC_DATE_1 and REC_TIME_1 specify Recording Date and Time for the whole VOB
 - 11b : REC_DATE_1 and REC_TIME_1 specify Recording Date and Time from the Start PTM of this VOB up to (but not including) the Change Field, REC_DATE_2 and REC_TIME_2 specify Recording Date and Time for the remaining part of the VOB.

(9) CHNG_FLD

May contain a positive integer value indicating the presentation time (Change Field PTM) within the presentation period of the current VOB where one or more of the recorded attributes change. CHNG_FLD is expressed in number of fields from the first displayed field of this VOB and shall be smaller than the number of encoded video fields in this VOB.

CHNG_FLD shall be greater than zero if RTA Validity or Rec Info Validity (or both) contains the value (11b).

Note 1: Only one attribute transition can be recorded within the VOB presentation period. In case the source signal contains more frequent changes, it is the responsibility of the recording device to select the most appropriate Change Field.

Note 2: CHNG_FLD and a second set of attributes are included to improve signalling accuracy. The value of CHNG_FLD has no defined relation with the GOP structure of the coded video stream.

(10) RT_ATR_1

Describes the Real-Time Attributes that are valid from the Start PTM of this VOB until the Change Field PTM or the End PTM, depending on the value of RTA Validity. These bytes are zero if RTA Validity contains the value (00b).

b15	b14	b13	b12	b11	b10	b9	b8
Aspect ratio				Subtitling mode		reserved	Film bit
b7	b6	b5	b4	b3	b2	b1	b0
CGMS		reserved	EPN	Surround Type		reserved	

Aspect ratio

...	1 000b :	4:3 full format
	0 001b :	14:9 letterbox, center position
	0 010b :	14:9 letterbox, top position
	1 011b :	16:9 letterbox, center position
	0 100b :	16:9 letterbox, top position
	1 101b :	>16:9 letterbox, center position
	1 110b :	14:9 full format, center position
	0 111b :	16:9 full format, center position
	Others :	Not allowed (b15 denotes the odd parity of b12, b13, b14, b15)

Note 1: Only if this field is (0111b), the aspect ratio of the reconstructed video is different from 4:3. The aspect_ratio_information field in the MPEG video sequence header shall always contain the value (0010b) indicating a 4:3 display aspect ratio. If sequence display extension information is present in an MPEG-2 video elementary stream, it shall be consistent with the VTS_V_ATR settings. Therefore Aspect ratio in PCI_GI Extension may switch between 16:9 and other modes, without starting a new Video Sequence in the coded video stream.

Note 2: If Aspect Ratio contains the value (0111b), both letterbox and pan-scan display modes are allowed.

Note 3: For details of Aspect ratio refer to ETSI EN 300 294 V1.3.2, 1998-04: *Television systems; 625-line television Wide Screen Signalling (WSS)*.

The default value for Aspect Ratio is (1000b), which indicates the same mode as the fixed values of the Aspect ratio and Source picture letterboxed fields in VTS_V_ATR of the VTSI.

Subtitling mode

...	00b :	No open subtitles
	01b :	Subtitles in active image area
	10b :	Subtitles out of active image area
	11b :	Reserved

The default value for Subtitling mode is (00b).

Note 4: For details of Subtitling mode refer to ETSI EN 300 294 V1.3.2, 1998-04: *Television systems; 625-line television Wide Screen Signalling (WSS)*.

Film bit ... 0b : Camera mode
 1b : Film mode

The default value for Film bit is (0b), which is identical to the value for the Film camera mode bit in VTS_V_ATR of the VTSI.

CGMS ... For definition refer to 2.2.2. See also 2.2.4.

EPN ... Encryption Plus Non-assertion flag indicating that the associated sectors are encrypted to restrict redistribution of content from a digital broadcast source.
 0b : The associated sectors are not encrypted.
 1b : The associated sectors are encrypted.

Note: The CP_METHOD flag in VRMI_GI indicates the encryption method (see 4.2).

Surround Type
 ... 00b : No surround sound information
 10b : Surround sound mode
 Others : Reserved

The default value for Surround Type is the value of Surround Type in Application Information in VTS_AST_ATRT in the VTSI of the VTS this VOBU belongs to (see also Annex C of [9]).

(11) RT_ATR_2

Describes the Real-Time Attributes that are valid from the Change Field PTM up to the End PTM of the VOBU. These bytes are zero if RTA Validity contains the value (00b) or (10b). The format of RT_ATR_2 is identical to RT_ATR_1.

(12) REC_DATE_1

Indicates the Recording Date of the video from the Start PTM of this VOBU until the Change Field PTM or the End PTM, depending on the value of Rec Info Validity. These bytes are zero if Rec Info Validity contains the value (00b).

b31	b30	b29	b28	b27	b26	b25	b24
Year (tens)				Year (units)			
b23	b22	b21	b20	b19	b18	b16	b17
Week			Month (tens)	Month (units)			
b15	b14	b13	b12	b11	b10	b9	b8
reserved		Day (tens)		Day (units)			
b7	b6	b5	b4	b3	b2	b1	b0
DS	TM	TZ Sign	Time Zone (tens)	Time Zone (units)			

Year ... Year of recording in 2-digit BCD format.
 [00]-[99] : Last two digits (tens and units) of year
 FFh : No information
 Others : Reserved

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3. Data structures in DVD-Video Zone

Week	...	Day of the week.
		0 : Sunday
		1 : Monday
		2 : Tuesday
		3 : Wednesday
		4 : Thursday
		5 : Friday
		6 : Saturday
		7 : No information
Month	...	Month of recording in 2-digit BCD format.
		[01]-[12] : January - December
		1Fh : No information
		Others : Reserved
Day	...	Day of the month in 2-digit BCD format.
		[01]-[31]: Day of the month.
		3Fh : No information
		Others : Reserved
DS	...	0b : Daylight saving time
		1b : Normal
TM	...	0b : 30 minutes additional time difference with UTC
		1b : No additional time difference
TZ Sign	...	Time Zone Sign. If Time Zone contains the value (1Fh), TZ Sign shall contain the value (1b).
		0b : Positive difference with UTC (local time is ahead of UTC)
		1b : Negative difference with UTC (local time is behind UTC)
Time Zone	...	Time zone in 2-digit BCD format.
		[00]-[14] : Time zone difference from UTC (hours)
		1F: No information
		Others : Reserved

(13) REC_TIME_1

Indicates the Recording Time in hours, minutes, seconds and video frames of the video at the Start PTM of this VOB. These bytes are zero if Rec Info Validity contains the value (00b).

b31	b30	b29	b28	b27	b26	b25	b24
Hour (tens)				Hour (units)			
b23	b22	b21	b20	b19	b18	b16	b17
Minute (tens)				Minute (units)			
b15	b14	b13	b12	b11	b10	b9	b8
Second (tens)				Second (units)			
b7	b6	b5	b4	b3	b2	b1	b0
Video Frame (tens)				Video Frame (units)			

Hour	...	Hours of Recording Time in 2-digit BCD format.
		[00]-[23] : Hours of Recording Time
		FFh : No information
		Others : Reserved

Minute ...	Minutes of Recording Time in 2-digit BCD format. [00]-[59] : Minutes of Recording Time FFh : No information Others : Reserved
Second ...	Seconds of Recording Time in 2-digit BCD format. [00]-[59] : Second of Recording Time FFh : No information Others : Reserved
Video Frame ...	Video frames of Recording Time. [00]-[29] : Video Frames in case the TV system is set to 525/60 [00]-[24] : Video Frames in case the TV system is set to 625/50 FFh : No information Others : Reserved

If any of Hour, Minute and Second is equal to FFh, all bytes of REC_TIME_1 shall be equal to (FFh). Video Frame may be set to (FFh), while the other fields are different from (FFh).

Note 5: Both drop frame and non-drop frame counting of video frames is allowed if the TV system is set to 525/60.

(14) REC_DATE_2

Indicates the Recording Date of the video from the Change Field PTM up to the End PTM of the VOB. These bytes are zero if Rec Info Validity contains the value (00b) or (10b).

The format of REC_DATE_2 is identical to the format of REC_DATE_1.

(15) REC_TIME_2

Indicates the Recording Time in hours, minutes, seconds and video frames of the video at the Change Field PTM of the VOB. These bytes are zero if Rec Info Validity contains the value (00b) or (10b).

The format of REC_TIME_2 is identical to the format of REC_TIME_1.

3.4.2 User Defined pack (UD_PCK)

In addition to the type of packs that are defined by the DVD-Video specification, DVD+RW Video allows for User Defined Packs. These packs contain a 14 byte Pack header followed by a 2034 byte private_stream_1 packet (as defined by [3]) with a sub_stream_id which is equal to (FFh) ("provider defined stream", as defined by [9]). DVD+RW Video recorders may use the data area of the packet in User Defined Packs for their own purpose.

3.4.3 IEC-60958 Audio packs (IEC_PCK)

DVD-Video Recorders equipped with a digital audio interface may record digital audio in a transparent way using the IEC-60958 Audio stream format as described in this section. The audio encoded in the IEC-60958 Audio stream shall be locked to the MPEG system clock frequency, i.e. the requirements apply as they are defined in [3] for the case that the system_audio_lock_flag in the Program Stream system header is set to (1b). If present, IEC-60958 Audio streams shall be continuous within a VOB and each VOB of the VOB shall contain at least one IEC-60958 Audio pack.

Note: DVD-Video players generally ignore IEC-60958 Audio streams. Therefore it is recommended that audio with a similar content (but maybe limited to stereo or of a lower quality) is recorded in a DVD-Video compatible mode.

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An IEC-60958 Audio pack (IECA_PCK) consists of a pack header of 14 bytes, an IEC-60958 Audio packet (IECA_PKT) and an optional padding packet. If present, the size of the padding packet is at least 8 bytes.

Field	Number of bits	Number of bytes	Value	Comment
packet_start_code_prefix	24	3	00 0001h	
stream_id	8	1	1011 1101b	private_stream_1
PES_packet_length	16	2		
'10'	2	3	10b	
PES_scrambling_control	2		00b	not scrambled
PES_priority	1		0	
data_alignment_indicator	1		0	not defined
copyright	1		0	not defined by descriptor
original_or_copy	1		1 or 0	original:1, copy: 0
PTS_DTS_flags	2		10b or 00b	
ESCR_flag	1		0	
ES_rate_flag	1		0	
DSM_trick_mode_flag	1		0	
additional_copy_info_flag	1		0	
PES_CRC_flag	1		0	
PES_extension_flag	1		0 or 1	
PES_header_data_length	8		0 to 15	
'0010'	4	5		PTS[32..0] shall be present in each packet containing the first byte of an access unit. PTS[32] shall be set to zero.
PTS [32 . . 30]	3			
marker_bit	1			
PTS [29 . . 15]	15			
marker_bit	1			
PTS [14 . . 0]	15			
marker_bit	1	1		These fields are only present in the first IECA_PCK within a Cell of which the first pack has an SCR equal to zero.
PES_private_data_flag	1		0	
pack_header_field_flag	1		0	
program_packet_sequence_counter_flag	1		0	
P_STD_buffer_flag	1		1	
reserved	3	2	111b	The value for buffer size is determined by historic reasons. Decoders should ignore this value.
PES_extension_flag_2	1		0	
'01'	2		01b	
P_STD_buffer_scale	1		1	
P_STD_buffer_size	13		58	
stuffing_byte	-	0 to 7		
Private data area				
sub_stream_id	8	1	1111 0000b	
reserved	8	1	0000 0000b	
first_access_unit_pointer	16	2		
channel_status	192	24		As defined by IEC-60958 / IEC-61937
IEC-60958 Audio data area				

sub_stream_id

This field contains the value (1111 0000b), identifying IEC-60958 Audio.

first_access_unit_pointer

The first_access_unit_pointer contains the address of the first byte of the first IEC-60958 Audio access unit relative to the last byte before the start of the IEC-60958 Audio data area (0001h means first byte of the IEC-60958 Audio data area). If there is no first byte of an audio access unit in the IEC-60958 Audio data area, the first_access_unit_pointer contains the value (0000h).

The PTS in the PES packet header contains the presentation time of the access unit indicated by the first_access_unit_pointer.

channel_status

This 192-bit field contains the Channel Status bits. See [15] for the definition of these bits. Mapping of Channel Status bits to bits of the channel_status field is as follows:

b191	b190	b189	b188	b187	b186	b185	b184
Bit 0	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7
b183	b182	b181	b180	b179	b178	b177	b176
Bit 8	Bit 9	Bit 10	Bit 11	Bit 12	Bit 13	Bit 14	Bit 15
..
Bit ..	Bit ..	Bit ..	Bit ..	Bit ..	Bit ..	Bit ..	Bit ..
b15	b14	b13	b12	b11	b10	b9	b8
Bit 176	Bit 177	Bit 178	Bit 179	Bit 180	Bit 181	Bit 182	Bit 183
b7	b6	b5	b4	b3	b2	b1	b0
Bit 184	Bit 185	Bit 186	Bit 187	Bit 188	Bit 189	Bit 190	Bit 191

The information encoded in the channel_status field is valid from the first access unit in the data area. If there is no first byte of an audio access unit in the IEC-60958 Audio data area, all bytes of channel_status contain the value (00h).

IEC-60958 Audio data area

The IEC-60958 Audio data area contains an even number of bytes from a sequence of IEC-60958 Audio access units. There is no requirement that IEC-60958 Audio access units are aligned with packets.

If channel_status indicates PCM data, an IEC-60958 Audio access unit consists of 192 2-channel samples. See Table 3-7.

Table 3-7: IEC-60958 Audio access unit for PCM data

2-channel sample #1
2-channel sample #2
.....
2-channel sample #192

Each 2-channel sample consists of an audio sample of a Channel 1 sub frame followed by an audio sample of a Channel 2 sub frame. If channel_status indicates a sample word length of 16 bits, each audio sample shall occupy 16 bits; otherwise each audio sample shall occupy 24 bits with unused least significant bits (if any) set to (0b).

The format of a 2-channel sample in the case that channel_status indicates a 16-bit word length is as follows:

b31	b30	b29	b28	b27	b26	b25	b24
Bit 27 (msb)		Audio sample of Channel 1 sub frame					Bit 20
b23	b22	b21	b20	b19	b18	b17	b16
Bit 19		Audio sample of Channel 1 sub frame					Bit 12 (lsb)
b15	b14	b13	b12	b11	b10	b9	b8
Bit 27 (msb)		Audio sample of Channel 2 sub frame					Bit 20
b7	b6	b5	b4	b3	b2	b1	b0
Bit 19		Audio sample of Channel 2 sub frame					Bit 12 (lsb)

The format of a 2-channel sample in the case that the channel_status indicates a word length different from 16 (or if the word length is not indicated) is as follows:

b47	b46	b45	b44	b43	b42	b41	b40
Bit 27 (msb)		Audio sample of Channel 1 sub frame					Bit 20
b39	b38	b37	b36	b35	b34	b33	b32
Bit 19		Audio sample of Channel 1 sub frame					Bit 12
b31	b30	b29	b28	b27	b26	b25	b24
Bit 11		Audio sample of Channel 1 sub frame					Bit 4 (lsb)
b23	b22	b21	b20	b19	b18	b17	b16
Bit 27 (msb)		Audio sample of Channel 2 sub frame					Bit 20
b15	b14	b13	b12	b11	b10	b9	b8
Bit 19		Audio sample of Channel 2 sub frame					Bit 12
b7	b6	b5	b4	b3	b2	b1	b0
Bit 11		Audio sample of Channel 2 sub frame					Bit 4 (lsb)

If channel_status indicates non-PCM data, an IEC-60958 Audio access unit consists of four 16-bit burst_preambles Pa, Pb, Pc and Pd, a burst_payload as defined in [17] and optionally up to 15 stuffing bits. The size of the burst payload in bits corresponds with the length_code specified in Pd. Stuffing bits shall be added to make the next audio access unit 16-bit aligned.

PAUSE bursts may be included in the bitstream to bridge gaps in the audio stream. If a sequence of one or more PAUSE bursts is included in the stream, the gap-length parameter shall be specified correctly for the first PAUSE burst. A sequence of PAUSE bursts may be followed by a next sequence of PAUSE bursts of which the first burst again contains a correct value for the gap-length parameter.

Note: According to [17] the use of the gap-length parameter is optional. Recording devices should take care of adding the gap-length values.

Table 3-8: IEC-60958 Audio access unit for non-PCM data

[illegible]

The MPEG2 P-STD buffer size for IEC-60958 Audio is 16 kB.

Access units are removed at once from the P-STD buffer at their PTS and decoded with zero latency. PTS values define the presentation time of the first audio sample of the access unit.

4. Video Recording Manager Information (VRMI)

4.1 Introduction

This chapter specifies the syntax and semantics of the Video Recording Management Information.

VRMI consists of the following fixed size parts (see also Figure 4: VRMI):

VRMI_GI: VRMI General Information (2048 bytes)

VRMI_CHPI: VRMI Chapter Information (4096 bytes)

49 VRMI_RECI blocks: Recording Information (25088 bytes)

VRMI_RES: Reserved area of VRMI (1536 bytes)

Note: The total size of VRMI is 32 kB.

VRMI General Information (VRMI_GI)
VRMI Chapter Information (VRMI_CHPI)
VRMI Recording Information #1 (VRMI_RECI #1)
:
VRMI Recording Information #49 (VRMI_RECI #49)
VRMI Reserved (VRMI_RES)

Figure 4: VRMI

4.2 VRMI General Information (VRMI_GI)

Table 4-1: VRMI_GI

RBP		Contents	Number of bytes
0	VRM_ID	VRM Identifier	12 bytes
12	reserved	reserved	16 bytes
28	VRMI_EA	End Address of VRMI	4 bytes
32	VERN	Version number of DVD_VR specification	2 bytes
34	VR_APP	VR Application	1 byte
35	reserved	reserved	3 bytes
38	VR_EAI	End address indicator for video files	2 bytes
40	VOBS_SAI	Start address indicator for Title VOBS	2 bytes
42	reserved	reserved	22 bytes
64	DSC_ST	Disc status	1 byte
65	CP_METHOD	Content Protection Method	1 byte
66	reserved	reserved	5 bytes
71	LAST_DATE	Date of last change	5 bytes
76	LAST_TIME	Time of last change	4 bytes
80	CP_DATA	Content Protection Data	17 bytes
97	reserved	reserved	19 bytes
116	DSC_KF_PNT	Pointer to disc key frame	8 bytes
124	DSC_NM_FMT	Disc name format	4 bytes
128	DSC_NM	Disc name	64 bytes
192	ALT_DSC_NM	Alternative disc name	64 bytes
256	MAN_ID	Manufacturer ID	32 bytes
288	MDL_ID	Player model ID	16 bytes
304	FRMW_ID	Firmware ID	16 bytes
320	MENU_LO_ID	Menu lay-out ID	2 bytes
322	reserved	Reserved	190 bytes
512	MAN_UD	Manufacturer's user data	512 bytes
1024	FTT_Ns	Number of Full Titles	1 byte
1025	DSC_PB_Ns	Number of entries in DSC_PB_SEQT	1 byte
1026	DSC_PB_SEQT	Disc playback sequence table	99 bytes
1125	reserved	reserved	27 bytes
1152	CELL_INFO_FLG	Indicates if CELL_INFO table is used	1 byte
1153	CELL_INFO	Content protection information for each cell	254 bytes
1407	reserved	reserved	129 bytes
1536	VRMI_GI_UD	VRMI_GI user data	512 bytes
Total			2048 bytes

(RBP 0) VRM_ID

Contains the string "DVDVRMANAGER" with a-characters of the ISO-646 character set.

(RBP 28) VRMI_EA

The size of this VRMI in number of logical blocks. For this version of the format VRMI_EA shall contain the value (0010h).

(RBP 32) VERN

Contains the version number of the DVD+RW Video format specification that VRMI complies to. VERN shall contain the value (0030h) if CELL_INFO_FLG contains the value (01h). It is recommended that VERN should contain (0030h) only if the specific features for version 3 are used on the disc, these features are for additional navigation structures of VCPS encoded material (see [22]).

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4. Video Recording Manager Information (VRMI)

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VERN shall contain the value (0020h) to indicate version 2 of the format specifications, unless compatibility with version 1 recorders is desired and none of the new features of version 2 are used. The differences between version 1 and version 2 are summarized in the following table.

Table 4-2: Differences between version 1 and version 2

Item	Version 1	Version 2.1	Version 3	Comment
VRMI_GI / VERN	'0010h'	'0020h'	'0030h'	
VRMI_GI / VR_APP VRMI_GI / VR_EAI VRMI_GI / CP_METHOD VRMI_GI / CP_DATA	Not defined	May be different from zero	May be different from zero	These fields are reserved in version 1
VRMI_GI / CELL_INFO_FLG VRMI_GI / CELL_INFO	Not defined	Not defined	May be different from zero	These fields are reserved in versions 1 and 2
VRMI_REC1 / REC_VOB_IFO	CP_stat not defined	CP_stat field may be different from zero	CP_stat field may be different from zero	CP_stat field is reserved in version 1.x.
Start address (LSN) of VTSTT_VOBS	(004000h)	(004000h), or with n times 256 sector offset	(004000h), or with n times 256 sector offset	n greater than or equal to zero
Other data files	May be recorded after video files, but no protection against overwrite	Separate Data Section for other data files	Separate Data Section for other data files	
Intermediate DVD+RW Video disc	Not defined	Possible, in case there is a Data Section	Possible, in case there is a Data Section	
Number of PGC commands	Always 3	From 1 up to 128 commands allowed	From 1 up to 128 commands allowed	
File system	-	Additional requirements if there is a Data Section	Additional requirements if there is a Data Section	

Note: Recorders should not make any changes to the content on the disc if they are designed for a lower version number of the DVD+RW Video specification than indicated by VERN. The recorder should play such a disc as a standard DVD-Video disc.

(RBP 34) VR_APP

Defines for which type of application the disc is used. If VERN is set to (0010h) then this field must contain (00h).

... 00h : Video application only
 01h : Combined video and data application. The disc contains a Data Section
 Others : Reserved

(RBP 38) VR_EAI

Indicates the address of the sector up to which video files may be recorded. If VR_APP is equal to (00h), VR_EAI has no meaning and shall be set to (0000h). If VR_APP is equal to (01h), VR_EAI multiplied by 256 defines the LSN of the first sector of the Data Section. The smallest non-zero value of VR_EAI is equal to VOBS_SAI + 72, allowing for at least 1 MB for the VTSTT_VOBS and 3 MB for the required backup files.

Note: The boundary between the video files and the Data Section may be shifted in the area between video and data files. However, this is not just a matter of changing the value of VR_EAI. Affected File System structures must be updated to reflect the change.

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4. Video Recording Manager Information (VRMI)

(RBP 40) VOBS_SAI

Indicates the start address of the VOBS for the Titles. VOBS_SAI multiplied by 256 specifies the offset between LSN=(004000h) and the first sector of the recorded video streams (VTSTT_VOBS). If VERN is set to (0010h) then this field must contain zero (0000h)

Note: It is recommended to set VOBS_SAI to (0000h) unless the additional space in front of the video streams is actually needed for additional menu features (e.g. for so-called motion menus). Once video has been recorded on the disc, the value of VOBS_SAI cannot easily be changed, as the recorded video stream contains offset values relative to the start of VTSTT_VOBS.

(RBP 64) DSC_ST

Contains information about the status of the disc.

b7	b6	b5	b4	b3	b2	b1	b0
TV system				reserved			

TV system

... The contents of this field shall be identical to the contents of all TV system attributes in VMGI and all VTSI.
00b : 525/60
01b : 625/50
Others : Reserved

(RBP 65) CP_METHOD

This field defines the content protection method that may have been applied to protect (part of) the recorded audio-visual content. If VERN shall be set to (0010h) then this field shall be zero (00h).

00h : No content protection method has been applied
01h : Content protection method is CPRM
02h : Content protection method is VCPS
Others : Reserved

Note: Recorders should not make any changes to content on the disc if CP_METHOD indicates a content protection method that is not supported by the recorder.

(RBP 71) LAST_DATE

This field may contain the date at which the last modification to VRMI was made.

b39	b38	b37	b36	b35	b34	b33	b32
Year (thousands)				Year (hundreds)			
b31	b30	b29	b28	b27	b26	b25	b24
Year (tens)				Year (units)			
b23	b22	b21	b20	b19	b18	b16	b17
Week			Month (tens)	Month (units)			
b15	b14	b13	b12	b11	b10	b9	b8
reserved		Day (tens)		Day (units)			
b7	b6	b5	b4	b3	b2	b1	b0
DS	TM	TZ Sign	Time Zone (tens)	Time Zone (units)			

Year ... Year in 4-digit BCD format.
[2000]-[9999] : Year in which last modification to VRMI was made

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FFFFh : No information
Others : Reserved

If Year contains the value (FFFFh) all other bits of LAST_DATE contain the value 1b, except for reserved fields.

Week ... Day of the week.

0 : Sunday
1 : Monday
2 : Tuesday
3 : Wednesday
4 : Thursday
5 : Friday
6 : Saturday
7 : No information

Month ... Month of the year in 2-digit BCD format.

[01]-[12] : January – December
1Fh : No information, only allowed if Year contains (FFFFh)
Others : Reserved

Day ... Day of the month in 2-digit BCD format.

[01]-[31] : Day of the month.
3F : No information, only allowed if Year contains (FFFFh)
Others : Reserved

DS ... 0b : Daylight saving time
1b : Normal

TM ... 0b : 30 minutes additional positive or negative time difference with UTC,
depending on TZ Sign
1b : No additional time difference

TZ Sign

... Time Zone Sign.

0b : Positive difference with UTC (local time is ahead of UTC)
1b : Negative difference with UTC (local time is behind UTC)

Time Zone ... Time zone in 2-digit BCD format.

[00]-[14] : Time zone difference from UTC (hours)
1F : No information
Others : Reserved

DS, TM and TZ Sign shall be set to (1b) if Time Zone contains the value (1Fh).

(RBP 76) LAST_TIME

This field may contain the local time of the day at the moment that the last modification to VRMI was made.

b31	b30	b29	b28	b27	b26	b25	b24
Hour (tens)				Hour (units)			
b23	b22	b21	b20	b19	b18	b16	b17
Minute (tens)				Minute (units)			
b15	b14	b13	b12	b11	b10	b9	b8
Second (tens)				Second (units)			
b7	b6	b5	b4	b3	b2	b1	b0
reserved							

Hour ... Hours in 2 digit BCD format.
 [00]-[23] : Hours of Recording Time
 FFh : No information
 Others : Reserved

If Hour contains the value (FFh), Minute and Second also contain the value (FFh).

Minute ... Minutes in 2 digit BCD format.
 [00]-[59] : Minutes of Recording Time
 FFh : No information
 Others : Reserved

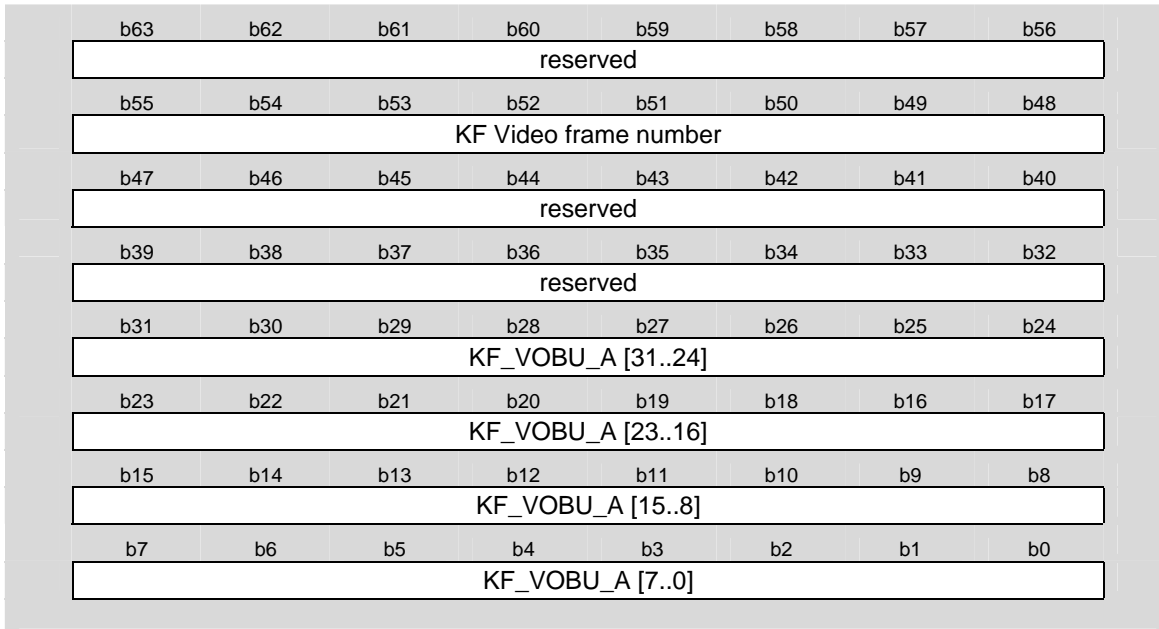
Second ... Seconds in 2 digit BCD format.
 [00]-[59] : Second of Recording Time
 FFh : No information
 Others : Reserved

(RBP 80) CP_DATA

The use of this 17-byte field is defined by the content protection system. Applications not familiar with the content protection system should leave this field unchanged, unless all protected audio-visual content is deleted or replaced. In case CP_METHOD is set to zero, all bytes of this field shall be set to (00h).

(RBP 116) DSC_KF_PNT

This field contains the Disc Key Frame Pointer according to the following format:

**KF Video frame number**

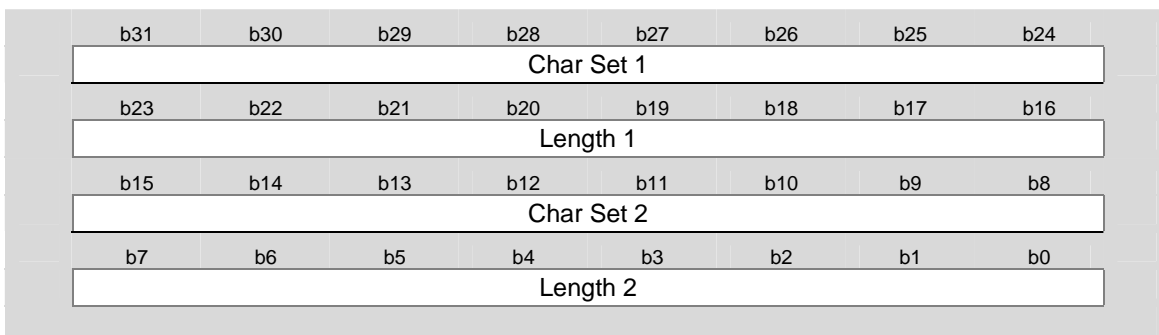
... Unsigned integer indicating which of the video frames within the presentation period of the VOBU referred to by KF_VOBU_A is the Key Frame for the disc. Counting of video frames starts from 1 at the beginning of the video presentation of the VOBU. If no Disc Key Frame has been selected, this field contains (00h).

KF_VOBU_A

... Contains the address of the NV_PCK that is the first sector of the VOBU containing the Disc Key Frame with RLBN from the first LB in the VTSTT_VOBS. If no Disc Key Frame has been selected, all bytes of this field contain (00h).

(RBP 124) DSC_NM_FMT

Defines the format of the DSC_NM and ALT_DSC_NM fields.

**Char Set 1**

... Defines the character set code used for DSC_NM.
 11h : ISO/IEC 8859-1
 Others : Reserved

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Length 1

... Specifies the number of bytes of DSC_NM in the range [0..64] that are used to describe the name of the disc.

Char Set 2

... Defines the character set code used for ALT_DSC_NM.

12h :	Shifted JIS Kanji, including JIS Roman [14] and JIS Katakana [13]
13h :	KSC 5601-1989 [149]
14h :	Chinese GB 2312-80 [58]
15h :	Big5
21h .. 2Fh :	ISO/IEC 8859-n, with n ranging from 2 (for '21h') to 16 (for '2Fh')
31h :	ISCII
Others :	Reserved

Note: The numbers in between square brackets [] are the ISO 2022 registration numbers.

Recommendation: The name of the disc can be represented with the Latin 1 character set in DSC_NM and/or an alternative character set in ALT_DSC_NM. Recorders should support at least the SPACE character and the G0 graphic character set of ISO/IEC 8859-1 (Latin 1) as a minimum. In addition, depending on local requirements, the G1 graphic character set of Latin 1 may be supported or one or more of the character sets defined by Char Set 2. If ALT_DSC_NM is recorded, it is recommended to also record a Latin 1 version in DSC_NM, if possible. When discs are exchanged between recorders with different character set capabilities, ALT_DSC_NM may become unusable for generating pixel-based text in menus. The Latin 1 version (DSC_NM) acts as an interchange format in that case. Preferably ALT_DSC_NM is not erased until the user changes DSC_NM or enters a new ALT_DSC_NM.

Length 2

... Specifies the number of bytes of ALT_DSC_NM that are used to describe the name of the disc by means of a character set different from Char Set 1. Length 2 is in the range [0..64]. If Char Set 2 specifies a double byte character code set, Length 2 shall be even.

(RBP 128) DSC_NM

Contains a character string starting from the first byte of this field representing the name of the disc. The characters are coded with the character set code defined by Char Set 1. Unused bytes contain the value (00h).

(RBP 192) ALT_DSC_NM

Contains a character string starting from the first byte of this field representing the name of the disc in an alternative format. The characters are coded with the character set code defined by Char Set 2. Unused bytes contain the value (00h).

(RBP 256) MAN_ID

Identifies the manufacturer of the recorder that generated the DVD-Video menu, by means of a string of ISO/IEC 8859-1 coded characters in the range [20h..7Eh], starting from the first byte position. Unused bytes contain the value (00h).

(RBP 288) MDL_ID

Identifies the model of the recorder that generated the DVD-Video menu, by means of a string of ISO/IEC 8859-1 coded characters in the range [20h..7Eh], starting from the first byte of this field. Unused bytes contain the value (00h).

(RBP 304) FRMW_ID

Identifies the firmware or software version of the recorder that generated the DVD-Video menu, by means of a string of ISO/IEC 8859-1 coded characters in the range [20h..7Eh], starting from the first byte of this field. Unused bytes contain the value (00h).

(RBP 320) MENU_LO_ID

Identifies the DVD-Video menu layout type. Syntax and semantics of this field are specified in Annex C).

(RBP 512) MAN_UD

This field may be used by the recorder that has generated the DVD-Video menu to store additional data.

(RBP 1024) FTT_Ns

Contains an unsigned integer in the range [1..49] indicating the number of Full Titles in the DVD-Video Zone.

(RBP 1025) DSC_PB_Ns

Unsigned integer in the range [0..99] specifying the number of used entries in the Disc Playback Sequence Table. When there is no alternative play back sequence defined for this disc, DSC_PB_Ns contains the value (00).

Note: The default play back behaviour is determined by the DVD-Video navigation structures.

(RBP 1026) DSC_PB_SEQT

Contains the Disc Playback Sequence Table, which specifies a user-defined alternative play back sequence of VR Play Lists starting from the first entry in the table. Each of the first DSC_PB_Ns entries of the table contains a one-byte number *n* indicating the VRPL of the *n*-th Recording. Only VRPLs of Recordings that are not deleted may be referenced. VRPLs may be referenced more than once in the sequence. Unused entries at the end contain the value (00h). All entries are zero if DSC_PB_Ns is zero.

(RBP 1152) CELL_INFO_FLG

This field indicates whether the CELL_INFO table that follows is used or not. When the CELL_INFO table is filled in, this field contains the value (01h). If the CELL_INFO table is not filled in then this field contains the value (00h).

If the value of CP_METHOD is set to (02h) indicating VCPS, then CELL_INFO shall contain the value (01h) and the CELL_INFO table shall be filled in.

(RBP 1153) CELL_INFO

This contains a table of 254 one-byte entries for each of the possible cells on the disc. The *n*-th entry in this table refers to the cell with cell-id *n*.

If an entry contains the value(01h) then the cell may contain encrypted data because a content protection method has been applied.

If an entry contains the value (00h) then it does not contain encrypted data, or the cell is not used on the disc.

If the value of CP_METHOD is (00h) then all entries contain the value (00h)

(RBP 1536) VRMI_GI_UD

The recorder that generated the DVD-Video menu may use this field to store additional information.

4.3 VRMI Chapter Information (VRMI_CHPI)

Table 4-3: VRMI_CHPI

RBP		Contents	Number of bytes
0	VRCHP_Ns	Number of VR Chapter Markers	1 byte
1	reserved	reserved	31 bytes
32	VRCHP_IT	VR Chapter Information Table, 254 16-byte entries	4064 bytes
Total			4096 bytes

(RBP 0) VRCHP_Ns

Unsigned integer in the range [0..254] indicating the number of VR Chapter Markers on the disc. If no video has been recorded on the disc yet or if all video has been deleted the value of VRCHP_Ns is 0.

(RBP 32) VRCHP_IT

Table containing VRCHP_Ns 16-byte VRCHPI blocks for all VR Chapter Markers. VRCHPI blocks start from the first byte of this table in the order of increasing CHP_VOBU_A. All bytes of unused VRCHP_IT entries at the end are filled with (00h).

Each VRCHPI block consists of an 8-byte VRCHP_MKI block followed by an 8-byte VRCHP_KFI block as shown in Table 4-4.

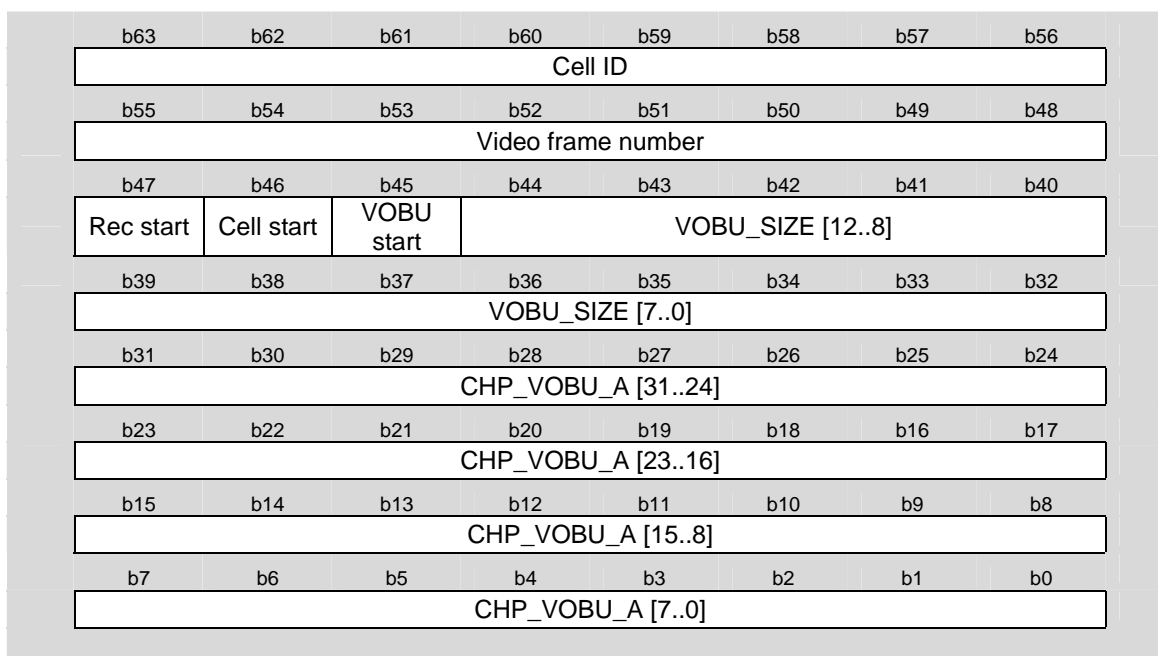
Table 4-4: VRCHPI

RBP		Contents	Number of bytes
0	VRCHP_MKI	VR Chapter Marker Information	8 bytes
8	VRCHP_KFI	VR Chapter Key Frame Information	8 bytes
Total			16 bytes

Each VRCHP_MKI identifies the first presentation frame of a VR Chapter.

Note: In general the last presentation frame of a VR Chapter is the last presentation frame before the first presentation frame of the next VR Chapter in VRMI_CHPI. However, the last presentation frame of the last VR Chapter of a Recording is the last presentation frame of the last Cell of the Full Title associated with this Recording.

Each VRCHP_KFI optionally identifies a key frame for the VR Chapter.

VRCHP_MKI

Cell ID ... Cell ID of the VOB that CHP_VOBU_A refers to.

Video frame number

... Unsigned integer indicating which of the video frames within the presentation period of the VOB referred to by CHP_VOBU_A contains the VR Chapter Marker. Counting of video frames starts from 1 at the beginning of the video presentation of the VOB.

Note: Playback devices may or may not support frame accurate VR Chapter playback. In the case that frame accurate VR Chapter playback is supported, playback devices should start the presentation of a VR Chapter from the video frame referred to by Video frame number. In case Video frame number points to a video frame preceding the first decoded I-frame (in display order) of an open GOP, the presentation may start at the decoded I-frame.

Rec start

... This bit is set to '1' if VRCHP_MKI refers to the start of the first Cell of the Full Title of a Recording. For each Recording that is not deleted, there is one and only one VRCHP_MKI with this bit set to '1'. If this bit is set to '1', the Cell start and VOB start bits are also set to 1 and Video frame number contains the value '1'.

Cell start

... This bit is set to '1' if VRCHP_MKI refers to the start of the first VOB of a Cell. If this bit is set to '1', the VOB start bit is also set to '1' and Video frame number contains the value '1'.

VOBU start

... This bit is set to '1' if VRCHP_MKI refers to the start of a VOB. If this bit is set to '1', Video frame number contains the value '1'.

VOBU_SIZE

... Unsigned integer specifying the number of MPEG-2 Program Stream packs contained in the VOB that CHP_VOBU_A refers to.

CHP_VOBU_A

... Contains the address of the NV_PCK that is the first sector of the VOB that contains the VR Chapter Marker with RLBN from the first LB in the VTSTT_VOBS. The VOB shall be part of a Cell that is included in the PGC of a Full Title of a Recording that is not deleted. A VOB shall have zero or one VR Chapter Markers. Therefore, no CHP_VOBU_A fields in VRMI_CHPI shall contain the same value.

VRCHP_KFI

b63	b62	b61	b60	b59	b58	b57	b56
reserved							
b55	b54	b53	b52	b51	b50	b49	b48
KF Video frame number							
b47	b46	b45	b44	b43	b42	b41	b40
reserved							
b39	b38	b37	b36	b35	b34	b33	b32
reserved							
b31	b30	b29	b28	b27	b26	b25	b24
KF_VOBU_A [31..24]							
b23	b22	b21	b20	b19	b18	b16	b17
KF_VOBU_A [23..16]							
b15	b14	b13	b12	b11	b10	b9	b8
KF_VOBU_A [15..8]							
b7	b6	b5	b4	b3	b2	b1	b0
KF_VOBU_A [7..0]							

KF Video frame number

... Unsigned integer indicating which of the video frames within the presentation period of the VOB referred to by KF_VOBU_A contains the Key Frame for this VR Chapter. Counting of video frames starts from 1 at the beginning of the video presentation of the VOB. If no Key Frame has been selected for this VR Chapter, this field contains (00h).

KF_VOBU_A

... Contains the address of the NV_PCK that is the first sector of the VOB in the VTSTT_VOBS containing the Key Frame associated with this VR Chapter with RLBN from the first LB in the VTSTT_VOBS. The value of KF_VOBU_A shall be greater than or equal to the value of CHP_VOBU_A and less than the value of the next occurrence of CHP_VOBU_A in VRCHP_IT or the end of the Recording the VOB is part of (whatever comes first). If no Key Frame has been selected for this VR Chapter, all bytes of this field contain (00h).

4.4 VRMI Recording Information (VRMI_REC1)

4.4.1 General

One Recording Information (VRMI_REC1) block is recorded for each Recording in VTSTT_VOBS. These blocks are recorded in the same order as the associated Full Titles in the (VCPS_)TT_SRPT¹ in VMGI, starting from the first VRMI_REC1. When there are less than 49 Recordings in the VTSTT_VOBS, empty VRMI_REC1 blocks are added at the end until there are 49 VRMI_REC1 blocks in total.

The value of REC_ST, which is the first byte of a VRMI_REC1 block, determines syntax and semantics of the other bytes of this VRMI_REC1 block.

(RBP 0) REC_ST

Indicates the status of this VRMI_REC1.

00h :	Empty VRMI_REC1.
01h :	VRMI_REC1 for Non-deleted Recording.
02h :	VRMI_REC1 for Deleted Recording.
Others :	Reserved

4.4.2 Empty VRMI_REC1

Table 4-5: VRMI_REC1

RBP		Contents	Number of bytes
0	REC_ST	Recording status	1 byte
1	reserved	reserved	511 bytes
Total			512 bytes

(RBP 0) REC_ST

Contains the value (00h) for an empty VRMI_REC1.

¹ VCPS_TT_SRPT if the additional VCPS structures are present, otherwise TT_SPRT

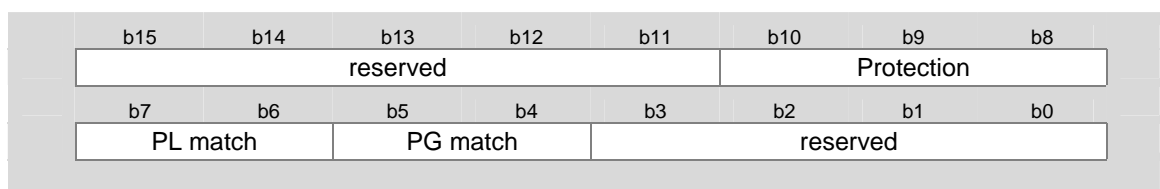
4.4.3 VRMI_RECI for Recording that is not deleted

Table 4-6: VRMI_RECI

RBP		Contents	Number of bytes
0	REC_ST	Recording status	1 byte
1	REC_MODE	Recording mode	2 bytes
3	REC_BRT	Bitrate of Recording	1 byte
4	REC_SRC	Recording source	1 byte
5	REC_CNT	Content category	1 byte
6	REC_VOB_IFO	Video Object information	1 byte
7	REC_DATE	Recording date	5 bytes
12	REC_TIME	Recording time	4 bytes
16	REC_PB_TM	Recording play back time	4 bytes
20	reserved	reserved	8 bytes
28	REC_E_A	End address of Recording	4 bytes
32	REC_VRCHP_Ns	Number of VR Chapter Markers	1 byte
33	reserved	reserved	19 bytes
52	REC_KF_PNT	Pointer to key frame for Recording	8 bytes
60	REC_NM_FMT	Format of name of Recording	4 bytes
64	REC_NM	Name of Recording	64 bytes
128	ALT_REC_NM	Alternative Recording name	64 bytes
192	VRPLI	VRPL Information	2 bytes
194	VRPL	VR Play List	99 bytes
293	reserved	reserved	155 bytes
448	VRMI_RECI_UD	RECI user data	64 bytes
Total			512 bytes

(RBP 0) REC_ST

Contains the value (01h) for a Non-deleted Recording.

(RBP 1) REC_MODE**Protection**

... 000b : It is allowed to overwrite or delete this Recording
 ... 111b : Recording shall not be overwritten or deleted
 ... Others : Reserved

PL match

... This field identifies how well the presentation of the DVD-Video compatible Play List Title for this Recording matches with the presentation of the VR Play List. Matching is possible if each VR Chapter included in the VR Play List has a related Chapter in the Play List Title. Matching can be with frame accuracy or VOBU accuracy.

In the case that frame accuracy is specified, all VR Chapters included in VRPL shall start and end at the same VOBU boundary as their related DVD Chapters in the Play List Title.

In the case that VOBU accuracy is specified, beginning and end of each VR Chapter included in VRPL shall match at least with VOBU accuracy:

- At the beginning of a Chapter VOBU accuracy is achieved when the first video frame of the VR Chapter is within the presentation period of the first VOBU of the related DVD Chapter or of the VOBU immediately in front of that and belonging to the same VOB.
- At the end of a Chapter VOBU accuracy is achieved when the last video frame of the VR Chapter is within the presentation period of the last VOBU of the related DVD Chapter or of the VOBU immediately located after that and belonging to the same VOB.

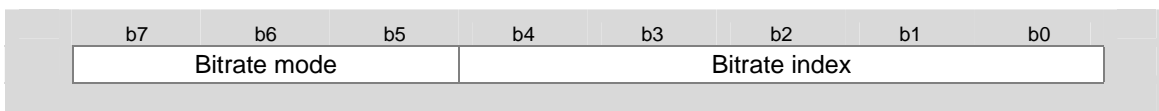
00b :	Play List matching unknown
01b :	Play List Title presentation doesn't match with VR Play List presentation
10b :	Play List Title presentation matches VR Play List presentation with VOBU accuracy
11b :	Play List Title presentation matches VR Play List presentation with video frame accuracy

PG match

... This bit is set if and only if for this Recording all Programs defined in the PGC_PGMAP of the PGCI for the Play List Title match with Programs defined in the PGC_PGMAP of the PGCI for the Full Title. A Program for the Play List Title matches with a Program for the Full Title when the contents of the related sequences of C_POSI blocks in the two Cell Position Information Tables (C_POSIT, at the end of the PGCI) are identical.

00b :	PGs in Play List Title are not identical to PGs in Full Title
01b :	PGs in Play List Title are identical to PGs in Full Title or Play List Title is empty
Others :	Reserved

(RBP 3) REC_BRT



Bitrate mode

...	000b :	Bitrate mode unspecified or unknown
	001b :	Constant bitrate (CBR)
	010b :	VR Constrained Variable Bitrate (CVBR)
	011b :	Unconstrained variable bitrate (VBR)
	100b :	Bitrate is a mixture of CBR and CVBR
	Others :	Reserved

Bitrate index

...	If Bitrate mode is (000b) or (011b), Bitrate index shall be 0 (Unspecified).	
	If Bitrate mode is (001b) or (010b), Bitrate index contains a value that is 3 less than the Bitrate level (BL) of all VOBs that are fully or partly included in this Recording.	
	If Bitrate mode is (100b), Bitrate index contains a value that is 3 less than the Bitrate level in the case that all VOBs that are fully or partly contained in this Recording have the same Bitrate level.	
	0 :	Unspecified
	[1..31] :	Bitrate level minus 3 (BL-3)

See Annex B for more information.

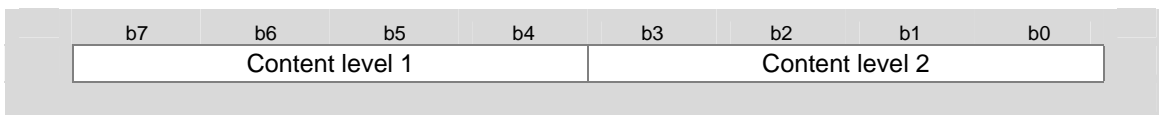
(RBP 4) REC_SRC

One byte field indicating the source of a recording:

...	00h :	Unspecified
	01h :	Analogue broadcasting
	02h :	Analogue camera
	03h :	Analogue unknown
	11h :	Digital broadcasting
	12h :	Digital camera
	13h :	Digital unknown
	FFh :	Mixed
	Others :	Reserved

(RBP 5) REC_CNT

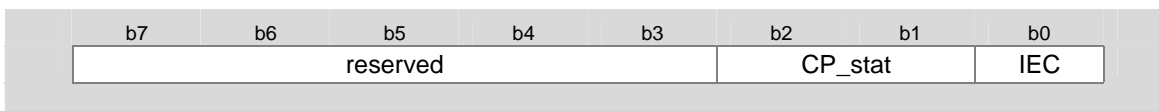
This one byte field may be used to classify the contents of a Recording.

**Content level 1**

...	0h :	Undefined
	Others :	Coded according to Content_nibble level 1 as specified for the Content descriptor by EN 300 468 [13].

Content level 2

...	0h :	Undefined
	Others :	Coded according to Content_nibble level 2 as specified for the Content descriptor by EN 300 468 [13].

(RBP 6) REC_VOB_IFO**IEC**

...	When this bit is set to (1b), each VOBUs included in the Full Title for this Recording contains one or more IEC-60958 Audio packs. When IEC is set to (0b), no IEC-60958 Audio packs are included in the Recording.
0b :	Recording contains no IEC-60958 Audio packs
1b :	Recording contains IEC-60958 Audio packs

CP_stat

...	Indicates the content protection status of the Recording. When the Content Protection Method field in VRMI_GI is zero, CP_stat shall be set to (00b).
00b :	No content protection method has been applied to any of the VOBUs of this Recording.
01b :	A content protection method may have been applied to some or all of the VOBUs of this Recording.
10b :	A content protection method has been applied at least to some but not to all of the VOBUs of the Recording.
11b :	A content protection method has been applied to all VOBUs of the Recording.

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Note: CP_stat may be set to (01b) after a Recording for which originally CP_stat was set to (10b) has been split, partially deleted or overwritten.

(RBP 7) REC_DATE

This field may contain the Recording Date: the date at the moment recording was started.

b39	b38	b37	b36	b35	b34	b33	b32
Year (thousands)				Year (hundreds)			
b31	b30	b29	b28	b27	b26	b25	b24
Year (tens)				Year (units)			
b23	b22	b21	b20	b19	b18	b16	b17
Week			Month (tens)	Month (units)			
b15	b14	b13	b12	b11	b10	b9	b8
reserved		Day (tens)		Day (units)			
b7	b6	b5	b4	b3	b2	b1	b0
DS	TM	TZ Sign	Time Zone (tens)	Time Zone (units)			

Year ... Year in 4-digit BCD format.
 [2000]-[9999] : Year of recording.
 FFFFh : No information
 Others : Reserved

If Year contains the value (FFFFh) all other bits of REC_DATE contain the value 1b, except for reserved fields.

Week ... Day of the week.
 0 : Sunday
 1 : Monday
 2 : Tuesday
 3 : Wednesday
 4 : Thursday
 5 : Friday
 6 : Saturday
 7 : No information

Month ... Month of the year in 2-digit BCD format.
 [01]-[12] : January - December
 1Fh : No information, only allowed if Year contains (FFFFh)
 Others : Reserved

Day ... Day of the month in 2-digit BCD format.
 [01]-[31]: Day of the month.
 3F : No information, only allowed if Year contains (FFFFh)
 Others : Reserved

DS ... 0b : Daylight saving time
 1b : Normal

TM ... 0b : 30 minutes additional positive or negative time difference with UTC, depending on TZ Sign
 1b : No additional time difference

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TZ Sign

... Time Zone Sign.
0b : Positive difference with UTC (local time is ahead of UTC)
1b : Negative difference with UTC (local time is behind UTC)

Time Zone Time zone in 2-digit BCD format.

... [00]-[14] : Time zone difference from UTC (hours)
1F : No information
Others : Reserved

(RBP 12) REC_TIME

This field may contain the Recording Time: the time at the moment recording was started.

b31	b30	b29	b28	b27	b26	b25	b24
Hour (tens)				Hour (units)			
b23	b22	b21	b20	b19	b18	b16	b17
Minute (tens)				Minute (units)			
b15	b14	b13	b12	b11	b10	b9	b8
Second (tens)				Second (units)			
b7	b6	b5	b4	b3	b2	b1	b0
reserved							

Hour ... Hours in 2-digit BCD format.
[00]-[23] : Hours
FFh : No information
Others : Reserved

If Hour contains the value (FFh), Minute and Second also contain the value (FFh).

Minute ... Minutes in 2-digit BCD format.
[00]-[59] : Minutes
FFh : No information
Others : Reserved

Second ... Seconds in 2-digit BCD format.
[00]-[59] : Second
FFh : No information
Others : Reserved

(RBP 16) REC_PB_TM

Contains the playing time of the Full Title. The format and contents are identical to PGC_PB_TM in PGCI.

(RBP 28) REC_E_A

Contains the address of the last Logical Block of this Recording with RLBN from the first LB in the VTSTT_VOBS.

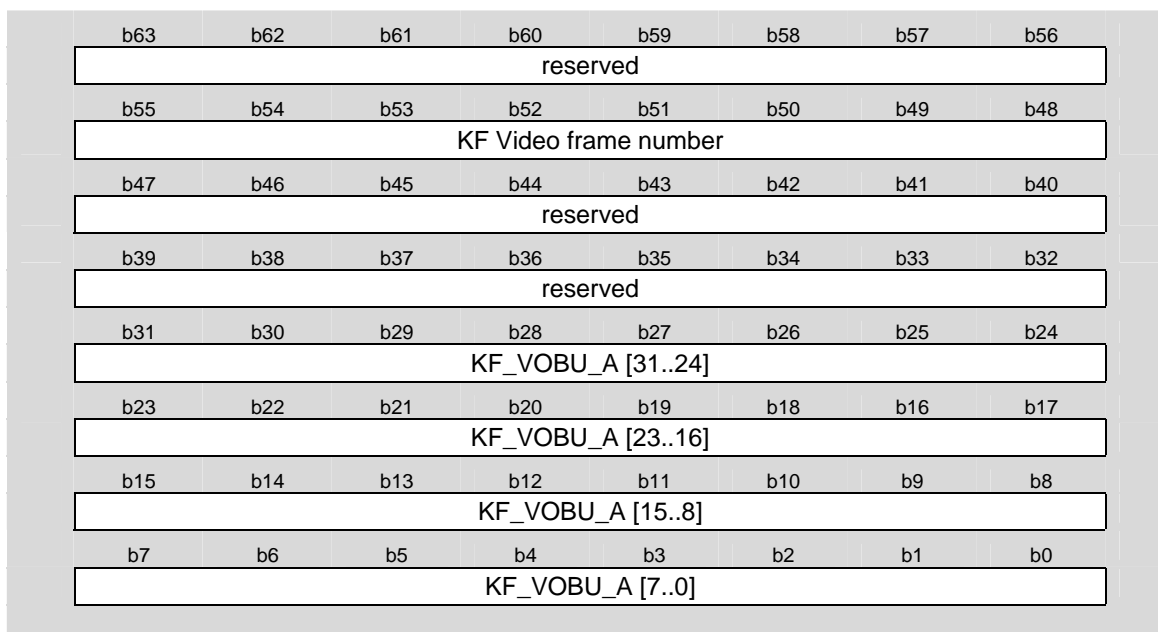
Note: If the current Recording is not the last Recording, the next one starts at REC_E_A of the current one plus 1. The start address of the first Recording is 0.

(RBP 32) REC_VRCHP_Ns

Number of (VR) Chapter Markers for this Recording in range [1..99]. See also Annex D.

(RBP 52) REC_KF_PNT

This field contains the Recording Key Frame Pointer according to the following format:

**KF Video frame number**

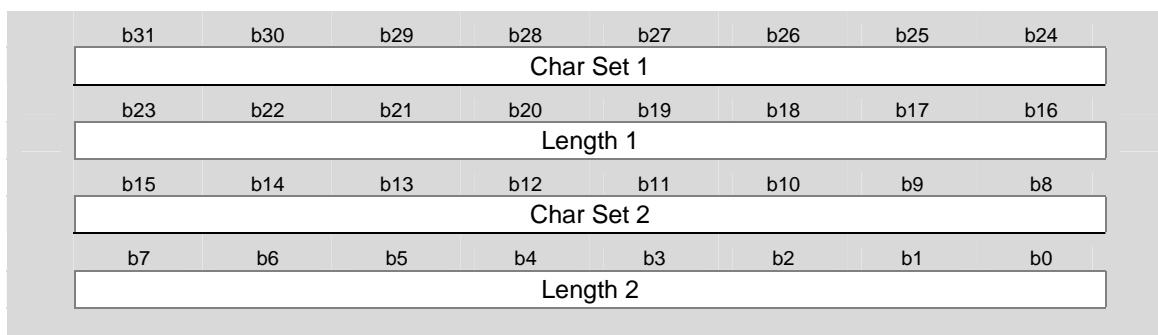
... Unsigned integer indicating which of the video frames within the presentation period of the VOBU referred to by KF_VOBU_A is the Key Frame for the Recording. Counting of video frames starts from 1 at the beginning of the video presentation of the VOBU. If no Recording Key Frame has been selected, this field contains (00h).

KF_VOBU_A

... Contains the address of the NV_PCK that is the first sector of the VOBU containing the Recording Key Frame with RLBN from the first LB in the VTSTT_VOBS. If KF Video frame number is not equal to (00h), KF_VOBU_A shall be greater than REC_E_A of the previous Recording (if present) and smaller than REC_E_A of the Recording in which it is included. If no Recording Key Frame has been selected, all bytes of this field contain (00h).

(RBP 60) REC_NM_FMT

Defines the format of the REC_NM and ALT_REC_NM fields.



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4. Video Recording Manager Information (VRMI)

Char Set 1

... Defines the character set code used for REC_NM.
11h : ISO/IEC 8859-1
Others : Reserved

Length 1

... Specifies the number of bytes of REC_NM in the range [0..64] that are used to describe the name of the Recording.

Char Set 2

... Defines the character set code used for ALT_REC_NM.
12h : Shifted JIS Kanji, including JIS Roman [14] and JIS Katakana [13]
13h : KSC 5601-1989 [149]
14h : Chinese GB 2312-80 [58]
15h : Big5
21h .. 2Fh : ISO/IEC 8859-n, with n ranging from 2 (for '21h') to 16 (for '2Fh')
31h : ISCII
Others : Reserved

Note: The numbers in between square brackets [] are the ISO 2022 registration numbers.

Recommendation: The name of a recording can be represented with the Latin 1 character set in REC_NM and/or an alternative character set in ALT_REC_NM. Recorders should support at least the SPACE character and the G0 graphic character set of ISO/IEC 8859-1 (Latin 1) as a minimum. In addition, depending on local requirements, the G1 graphic character set of Latin 1 may be supported or one or more of the character sets defined by Char Set 2. If ALT_REC_NM is recorded, it is recommended to also record a Latin 1 version in REC_NM, if possible. When discs are exchanged between recorders with different character set capabilities, ALT_REC_NM may become unusable for generating pixel-based text in menus. The Latin 1 version (REC_NM) acts as an interchange format in that case. Preferably ALT_REC_NM is not erased until the user changes REC_NM, enters a new ALT_REC_NM or when the Recording itself is deleted.

Length 2

... Specifies the number of bytes of ALT_REC_NM that are used to describe the name of the Recording by means of a character set different from Char Set 1. Length 2 is in the range [0..64]. If Char Set 2 specifies a double byte character code set, Length 2 shall be even.

(RBP 64) REC_NM

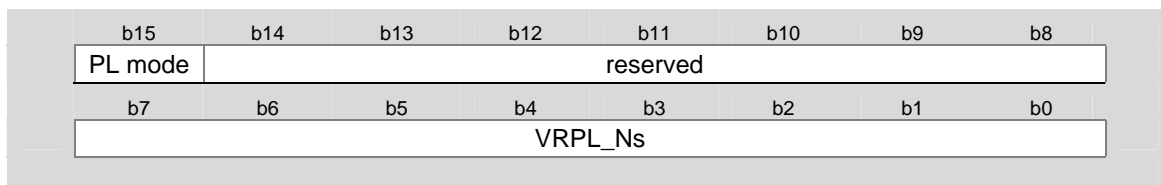
Contains a character string starting from the first byte of this field representing the name of the Recording. The characters are coded with the character set code defined by Char Set 1. Unused bytes contain the value (00h).

(RBP 128) ALT_REC_NM

Contains a character string starting from the first byte of this field representing the name of the Recording in an alternative format. The characters are coded with the character set code defined by Char Set 2. Unused bytes contain the value (00h).

(RBP 192) VRPLI

Contains information about the VR Play List.



PL mode

- ... 0b : Chapter references in VRPL are in ascending order.
 1b : Chapter references in VRPL are not in ascending order. Chapter references
 may be in arbitrary order and chapters may be referenced more than once.

VRPL_Ns

- ... Unsigned integer in the range [0..99] indicating the Number of chapter references in
 the VR Play List.

Note: PL mode shall be set to (0b) in case VRPL_Ns is 0 or 1.

(RBP 194) VRPL

Contains the user defined VR Play List. Each of the first VRPL_Ns single byte entries of VRPL contain an unsigned integer indicating a chapter number in the range from 0 to REC_VRCHP_Ns - 1. Chapter numbers are relative to the 1st VR Chapter of this Recording (0 indicates the 1st VR Chapter). Unused entries contain (FFh).

(RBP 448) VRMI_REC1_UD

The recorder that generated the DVD-Video menu may use this field to store additional information.

4.4.4 VRMI_RECI for Deleted Recording**Table 4-7: VRMI_RECI**

RBP		Contents	Number of bytes
0	REC_ST	Recording status	1 byte
1	reserved	reserved	27 bytes
28	REC_E_A	End address of Recording	4 bytes
32	reserved	reserved	416 bytes
448	VRMI_RECI_UD	RECI user data	64 bytes
		Total	512 bytes

(RBP 0) REC_ST

Contains the value (02h) for a Deleted Recording.

(RBP 28) REC_E_A

Contains the address of the last Logical Block of this Deleted Recording with RLBN from the first LB in the VTSTT_VOBS.

(RBP 448) VRMI_RECI_UD

The recorder that generated the DVD-Video menu may use this field to store additional information.

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A. Guidelines for DVD-Video players

A.1 Introduction

The data structures in the DVD-Video Zone on DVD+RW Video discs are a specially redesigned version of the DVD-Video format for read-only discs. The rules for data allocation and some details of the navigation data in the real-time data streams are adapted to enable real-time recording. In most cases the playback performance of DVD+RW Video discs on DVD-Video playback devices is not affected by these differences. Perfect playback can be assured by following the guidelines below.

A.2 Allocation of DVD-Video files

Playback devices can fully rely on the data allocation information provided by the File System, the Video Manager Information and Video Title Set Information. However, they should not depend on the strict rules for file ordering as suggested by the DVD-Video specifications for read-only discs.

A.3 VOBS Structures

The implementation rules for the Video Object Set data structures are slightly different from the rules for read-only discs. For correct playback devices should be robust against:

- different VOBs with the same VOB IDN in the VTSTT_VOBS
- non-sequential numbering of Cells within a VOB
- beginning or end of a VOB overwritten or not recorded (and not addressed in Program Chain)
- reliable but inaccurate forward search pointers (see A.4)
- packs in the real-time stream containing a private_stream_1 packet with a provider defined stream (mentioned in the DVD-Video specification, but not clearly defined)
- new data stream types in packs with a private_stream_1 packet with a sub_stream_id different from the ones defined in DVD-Video.

A.4 Forward Pointers

On DVD+RW Video discs the forward pointers in the data stream can still be used for forward search as they always point to either a navigation pack or to the end of the current cell. However, the forward pointers may not always indicate the navigation pack with the expected elapsed time. In general the short distance pointers are correct. Long distance pointers indicate either a navigation pack at a shorter than expected distance or the end of the current cell.

A.5 Stream Information

More audio streams may be indicated than that are actually recorded on a DVD+RW Video disc. The availability flag in the program chain for a title indicates which of the audio streams are actually used. Always one sub-picture stream is indicated, even if there are no sub-pictures recorded.

The rules for DVD-Video imply that cell addresses are increasing with cell numbers. Playback devices should not rely on this as it is not always the case on a DVD+RW Video disc. Also, in the case of DVD+RW Video seamless playback may be flagged (and is possible) between cells with non-incremental numbers.

A.6 Reserved fields

In rare cases DVD+RW Video utilises fields that are reserved in DVD-Video. Playback devices should ignore these reserved fields.

A.7 Media Compatibility

Refer to the DVD+RW Basic Format Specifications.

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B. Bitrate modes and levels

B.1 Constant bitrate recording (CBR)

For constant bitrate Recordings with a known bitrate, the Bitrate mode field of REC_BRT in VRMI_RECI in VRMI specifies CBR.

CBR Recordings are characterised by the fact that the differences between the SCRs of any two consecutive packs (ΔSCR) within the same VOB have the same fixed value for all VOBs that are fully or partly contained in the Recording.

If Bitrate Level is 4:

$$\Delta\text{SCR} = 45530$$

If Bitrate Level is in the range [5..34] there is a fixed relation between ΔSCR and the Bitrate level (BL):

$$\Delta\text{SCR} = \text{BL} \times 10900$$

Note: Bitrate level is in the range [4..34]. Bitrate index, which by definition is 3 less than Bitrate level, is a parameter that is recorded in REC_BRT in VRMI_RECI of the Recording.

Note: The fixed_flag in the MPEG-2 Program Stream system header shall be set to (0b) even in the case of CBR to improve compatibility.

B.2 Constrained variable bitrate (CVBR)

For constrained variable bitrate Recordings, the Bitrate mode field of REC_BRT in VRMI_RECI in VRMI specifies CVBR. For these Recordings the following restriction applies.

For any piece AB of a Recording containing a discrete number of consecutive VOBUs within the same VOB, with

VST_A = VOBUS_PTM of first VOB of AB
 VET_B = VOBUS_PTM of last VOB of AB
 $VSBA$ = NV_PCK_LBN of first VOB of AB
 VEB_B = NV_PCK_LBN + VOBUS_EA of last VOB of AB
 ΔSCR^* : ΔSCR for a CBR stream recorded with the same BL as the CVBR stream

and

$$\begin{aligned}
 \text{Playback_Time} &= (VET_B - VST_A) / 90000 && \text{(seconds)} \\
 \text{CBR_Time} &= (VEB_B - VSBA) \times \Delta\text{SCR}^* / (27 \times 10^6) && \text{(seconds)}
 \end{aligned}$$

the following comparison shall be true:

$$| \text{Playback_Time} - \text{CBR_Time} | \leq 37.5 \times \text{BL} \text{ (seconds)}$$

Note: ΔSCR shall be greater than or equal to 43886 in any case as a consequence of the fixed value for muxrate in the MPEG2 pack header.

B.3 Mixture of CBR and CVBR

If the Bitrate mode field of REC_BRT in VRMI_RECI specifies a mixture of CBR and CVBR, VOBs that are fully or partly contained in the Recording either fulfil the constraints for CBR recordings or for CVBR recordings with the same Bitrate level.

B.4 Recommended quality levels

Recommended quality levels are listed in Table 4-8. The figures for bitrate and recording time in the table apply for the case that the full capacity of a 12-cm DVD+RW disc is used for CBR recording at one Bitrate level.

Table 4-8: Recommended quality levels

Quality Level		Bitrate level	Bitrate (Mbps)	Recording time (h:mm:ss)
Mnemonic	Name			
HQ	High Quality	4	9.716	1:04:00
SP	Standard Play	8	5.073	2:02:34
LP	Long Play	12	3.382	3:03:51
EP	Extended Play	16	2.537	4:05:08
SLP	Super Long Play	24	1.691	6:07:43
SEP	Super Extended Play	32	1.268	8:10:17

C. Menu Layout Type

C.1 Introduction

DVD+RW Video recorders are free to determine the complexity and look and feel of the Title Menu, the contents of the Pre- and Post-commands of the Title PGCs and whether or not (and how) Titles are linked by means of the Next Title PGC. Furthermore recorders might store additional information in a VRMI User Data file.

Recorders may want to use the freedom in VRMI, VMGI and VTSI for instance to create a better user interface. They can exploit the particular way they have filled in the navigation data structures to bring down the time needed to update the Title Menu, e.g. by updating one menu page rather than a full set of pages. This is only possible if recorders have a way to check that these navigation aspects are according to its own standards. For this purpose recorders are required to update the MENU_LO_ID parameter whenever they change the contents of any of the VRMI, VMGI or VTSI files.

C.2 MENU_LO_ID

MENU_LO_ID is a 2-byte field in VRMI_GI identifying the Menu Layout Type used on this disc. Menu Layout IDs are issued by Philips on request. See cover page of this document for contact information. Companies requesting a Menu Layout ID may want to make available the specification of their Menu Layout Type to third parties, but don't have an obligation to do so.

C.3 Unspecified Menu Layout Type

The Menu Layout Type may be unspecified. In that case MENU_LO_ID is set to (0000h) and there are no restrictions other than those defined in this DVD+RW Video specification. This MENU_LO_ID is available for free use.

C.4 Native and foreign discs

After a first recording has been made on a blank disc, recorders will specify their Menu Layout Type by means of the MENU_LO_ID in VRMI_GI. As long as the disc is used in recorders with the same Menu Layout Type, the MENU_LO_ID will stay the same. For these recorders this is a native disc.

Foreign discs have a MENU_LO_ID different from the one written by the recorder itself. Depending on whether the interaction style of the recorder depends on certain properties of the own Menu Layout Type, foreign discs and native discs may be treated in different ways.

When recordings are added to a foreign disc and the navigation data structures need to be updated, the foreign disc is usually converted to a native disc. In such a case recorders should issue an appropriate warning before starting the recording.

Advanced recorders may be able to generate and maintain more than one Menu Layout Type.

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D. Restrictions

D.1 List of restrictions

Item	Restriction	Comment
# Recordings	0..49	
# Full Titles	1..49	Can be one more than no. of Recordings. Refer to 3.2.6.
# Play List Titles	1..49	Equal to No. of Full Titles
# Titles	2..98	2x No. of Full Titles
# Cells used by Full TT PGCs	1..254	These are the "used Cells".
# PGs in each Title	1..99	
# PGs in each Play List Title	1..99	In addition: up to 2x # PGs in related Full Title
# PGs in all Real Full Titles	1..254	PGs in Free Space Titles not included in count
# PGs in all Real Play List Titles	1..508	PGs in Free Space Titles not included in count
# C_PBI in each Full Title PGCi	1..254	
# C_PBI in each Play List PGCi	1..255	255 is DVD-Video limit
# C_PBI in all Real Full Title PGCIs	1..254	C_PBI of Free Space Titles not included in count
# C_PBI in all Real Play List PGCIs	1..508	C_PBI of Free Space Titles not included in count
# VRCHP per Recording	1..99	
# VRCHP_Ns (total)	0..254, ≤ 254 – Cres	See recommendations below.
VRPL_Ns	0..99	In addition: up to 2x # VRCHP for this Recording
Sum of all VRPL_Ns	0..508	Consequence of the rules above
Cell Playback Time (C_PBTM) if Bitrate index equal to 0	≤ 255.6	seconds
Cell Playback Time (C_PBTM) if Bitrate index greater than 0	≤ ΔSCR / 1450	seconds

D.2 Recommendations

- (1) A certain amount of Cell IDs should be reserved for future recording in the available Free Space on the disc. This amount (*Cres*) is calculated by determining the Free Space Capacity in number of free ECC blocks (FSC) and applying the following formula:

$$Cres = (FSC \text{ DIV } 1166) + 1$$

FSC can be calculated by determining the number of 32 kB blocks (ECC blocks) fully or partly occupied by Non-deleted Recordings from the information in the VRMI_REC1 blocks and subtracting this from the initial FSC value (142324 in the case of a 12-cm disc). For an empty 12-cm disc *Cres* = 123.

- (2) A certain amount of Cell IDs should be kept reserved for conversion of VR Play Lists into Play List Titles. This amount (*Cplan*) is equal to the number of VR Chapter Markers in VRMI_CHPI with the Cell start bit in VRCHP_MKI cleared.

- (3) The recorder should attempt to guarantee that the following equation be true when a DVD+RW Video disc is ejected:

$$Cused + Cres + Cplan \leq 254$$

with *Cused* being the number of Cells that are actually used by (non-deleted) Recordings. *Cused* can be determined by counting the number of Cell Pieces with non-zero end addresses in all VTS Cell Address Tables.

D.3 Notes on implementation

Note 1: It is recommended that when new recordings are made, recorders create Cells that are at or close to the maximum allowed Playback time at the selected bitrate.

Note 2: When the user creates VR Play Lists, the available budget for *Cplan* could potentially be exceeded. It is recommended that Recorders avoid this situation.

Note 3: It will not always be possible to fulfil the rule at (3). This is for instance the case when content recorded with variable bitrate and relatively big Cells is (partly) deleted or overwritten and in the same time the disc contains intensively edited content. This may lead to a situation that during recording the recorder runs out of available Cell IDs before the disc is completely full. When recording in free space at the end of the disc, the recorder might stop recording and indicate that the disc is full. When overwriting an existing Recording or in free space in front of another existing Recording, the recorder might have to delete Cells from the existing Recording before actually overwriting these Cells.

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E. Find a Title's PGC

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E. Find a Title's PGC

Example with 9 Recordings in one VTS

Title		VMGI / TT_SRPT / TT_SRP _s				VTSI / VTS_PTT_SRPT / TTUs		VTSI / VTS_PGCIT / VTS_PGC_SRP _s	
		TT_SRP#	TT_PB_TY	PTT_Ns	VTSN	VTS_TTN	PGCN	PGN	VTS_TTN
Play List Titles		1	000101 01	2	1	1	1	1 2	1
		2	000101 01	1	1	2	2	1	2
		3	000101 01	1	1	3	3	1	3
		4	000101 01	4	1	4	4	1 2 3 4	4
		5	000101 01	1	1	5	5	1	5
	Edited Play List (compare with 16)	6	000101 01	3	1	6	6	1 2 3	6
		7	000101 01	1	1	7	7	1	7
	Free Space	8	000101 11	1	1	8	8	1	8
		9	000101 01	1	1	9	9	1	9
	Free Space at end	10	000101 11	1	1	10	10	1	10
Full Titles		11	000101 01	2	1	11	11	1 2	11
		12	000101 01	1	1	12	12	1	12
		13	000101 01	1	1	13	13	1	13
		14	000101 01	4	1	14	14	1 2 3 4	14
		15	000101 01	1	1	15	15	1	15
		16	000101 01	5	1	16	16	1 2 3 4 5	16
		17	000101 01	1	1	17	17	1	17
	Free Space	18	000101 11	1	1	18	18	1	18
		19	000101 01	1	1	19	19	1	19
	Free Space at end	20	000101 11	1	1	20	20	1	20

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List of Changes

Differences between

System Description DVD+RW, Video Format Specifications, **version 2.1, June 2004**
and System Description DVD+RW, Video Format Specifications, **Version 3.0, July 2005**

Main change:

- Support for the additional navigation structures in the case of a VCPS protected disc.

See the table below for a list of changed sections.

Section	Location	Version 2.1	Version 3	Comment
1.1	At end	-	Updated to indicate new functionality	Editorial
1.4	At end	-	Added reference to VCPS specification	
3.1	At end	-	"In the case of a disc that makes use of the VCPS..."	General explanation of use of additional navigation structures for VCPS disc
3.2.5	4 th paragraph	-	"When the additional VCPS structures exist..."	Explanation of use of additional navigation structures for VCPS disc
3.3.2	Table 3-2	-	Entries added for the four additional VCPS navigation structures and the maximum size modified to accommodate this	
3.3.3	Table 3-4	-	Entries added for the four additional VCPS navigation structures and the maximum size modified to accommodate this	
4.2	Table 4-1		CELL_INFO_FLG and CELL_INFO table added	This provides the recorder with information about which cells have encrypted information.
4.2	(RBP 32) VERN	Can contain values (0010h) and (0020h)	Can contain values (0010h), (0020h) and (0030h)	Version can be 3 when additional navigation structure is used for playback of VCPS encrypted material
	(RBP 34) VR_APP (RBP 40) VOBS_SAI		Text changes to allow for VERN (0030h)	
4.2	Table 4-2		CELL_INFO_FLG and CELL_INFO table added	Editorial
4.2	Near end		Description of CELL_INFO_FLG and CELL_INFO table	

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